Exploring the Relationship between Interaction Capabilities and SMEs' Participation in Larger Customers' Supply Chains

by

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ABSTRACT

Globalisation has had a significant impact on the world and changed the landscape of manufacturing. Owing to this, UK manufacturing has to face challenges from both advanced economies, such as France, Germany, Japan and the US, as well as developing economies, such as Brazil, Russia, India and China (BRIC). To respond to this challenge, UK manufacturing needs to differentiate itself by shifting its focus towards high value manufacturing (HVM) as it has strong potential to bring sustainable growth to the UK economy. Technological advancement in the cyber-physical age enables companies to connect and create supply chains (SCs) in ways that were not previously possible. This presents an opportunity for small and medium sized enterprises (SMEs) to participate and increase their participation in larger customers' SCs. However, this requires SMEs to have the capability to interact effectively with their larger customers.

This research explores the relationship between interaction capabilities, SMEs' participation and firm performance. Interaction capabilities are a relatively new concept in an SC context, with existing studies more focused on the marketing domain. There are four types of interaction capabilities: human, managerial systems, technological and cultural. To examine these relationships, three sequential phases were involved. First, a reliable and valid scale for measuring interaction capabilities was developed. After developing the scale, data were collected by surveying 181 UK HVM SMEs. The survey data, then, were validated by two in-depth case studies.

Of the four interaction capabilities, the results suggest SMEs have human interaction capability (HIC) in place as it significantly improves their firm performance. Additionally, acquiring HIC would support the development of other capabilities such as technological interaction capability (TIC) and cultural interaction capability (CIC). This research also indicates that SMEs should consider developing capabilities to support managerial interaction capability (MIC) if they wish to grow their business with larger customers and in turn improve their business performance.

Keywords:

Capability, mid-sized, survey research, interaction approach, scale development

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LIST OF ABBREVIATIONS

AWU	Annual work unit
AMOS	Analysis of Moment Structures
ASEAN	Association of Southeast Asian Nations
AVE	Average variance extracted
BRIC	Brazil, Russia, India, China
BSC	Balanced scorecard
BSREC	Biomedical and Scientific Research Ethics Committees
CEO	Chief executive officer
CFA	Confirmatory factor analysis
CFI	Comparative fit index
CIC	Cultural interaction capability
EDI	Electronic data exchange
EFA	Exploratory factor analysis
GDP	Gross domestic product
GSCs	Global supply chains
GTMA	Gauge and Tool Makers Association
GVA	Gross value added
GVCs	Global value chains
HIC	Human interaction capability
HVM	High value manufacturing
ICTs	Information communication technologies
IMM	Industrial Marketing Management
IOS	Interorganisational system
IP	Intellectual property
IT	Information technology
IS	Information systems
JIT	Just-in-time
JOM	Journal of Operations Management
KMO	Kaiser-Meyer-Olkin
LEs	Large enterprises
MD	Managing Director
ME	Medium enterprise
MIC	Managerial systems interaction capability
MNCs	Multinational corporations
MNEs	Multinational enterprises
M&A	Mergers and acquisitions
n.e.c	Not elsewhere classified

NDA	Non-disclosure agreement
NFI	Normed fit index
NPD	New product development
NPI	New product introduction
OEMs	Original equipment manufacturers
OM	Operations management
OR	Operational research
OSCM	Operations supply chain management
PAF	Principal axis factoring
PCA	Principal component analysis
PIL	Participant information leaflet
PIMS	Performance improvement measurement system
PMSs	Performance measurement systems
POM	Production and Operations Management
Q-sort	Questionnaire sorting
R&D	Research and development
RBV	Resource-based view
RMSEA	Root mean square approximation of error
ROA	Return on assets
ROCE	Return on capital employed
ROE	Return on equity
ROI	Return on investment
ROS	Return on sales
SC	Supply chain
SCC	Supply chain collaboration
SCM	Supply chain management
SEM	Structural equation modelling
SIC	Standard industrial classification
SPSS	Statistical Package for the Social Sciences program
SMEs	Small and medium sized enterprises
SMED	Single-minute exchange of die
SMTs	Senior management teams
SWOT	Strengths, Weaknesses, Opportunities, and Threats
TIC	Technological interaction capability
TLI	Tucker-Lewis index
TQM	Total quality management
TSB	Technology Strategy Board
VRIN	Valuable, rare, inimitable and non-substitutable

1 INTRODUCTION

1.1 Introduction

The purpose of this chapter is to determine the research problem related to small and medium sized enterprises' (SMEs') capabilities in increasing their participation in larger customer supply chains (SCs). The chapter begins by addressing the importance of manufacturing in the UK and the issues faced by the industry as a result of globalisation (Section 1.2). Despite these issues, Section 1.2 presents some positive outlooks for global manufacturing, which have given a significant potential for UK SME manufacturers to increase their participation in larger customers' SCs, specifically in the context of high value manufacturing (HVM) SCs. In Section 1.3, the chapter discusses the challenges faced by SMEs which have affected their ability to increase participation. Section 1.3 also shows that these difficulties have been exacerbated by the practices of some large enterprises (LEs), limiting the growth of SMEs in HVM SCs. Thus, this research focuses on exploring the capabilities required by SMEs in order to interact effectively with their larger customers. The chapter continues in Section 1.4 by revealing gaps in the research in the area of buyer-supplier relationships and capabilities, specifically from an SME perspective. Then, in Section 1.5, the chapter presents the overarching research question of this research, which is to explore the role of interaction capabilities in increasing SMEs' participation in larger customers' SCs, and subsequently improve firm performance. The dearth of previous studies on inter-firm capabilities enhances the value of this research, specifically in the context of HVM SCs, as described in Section 1.6. Finally, the structure of the thesis is presented in Section 1.7. Figure 1-1 illustrates the structure of this chapter.

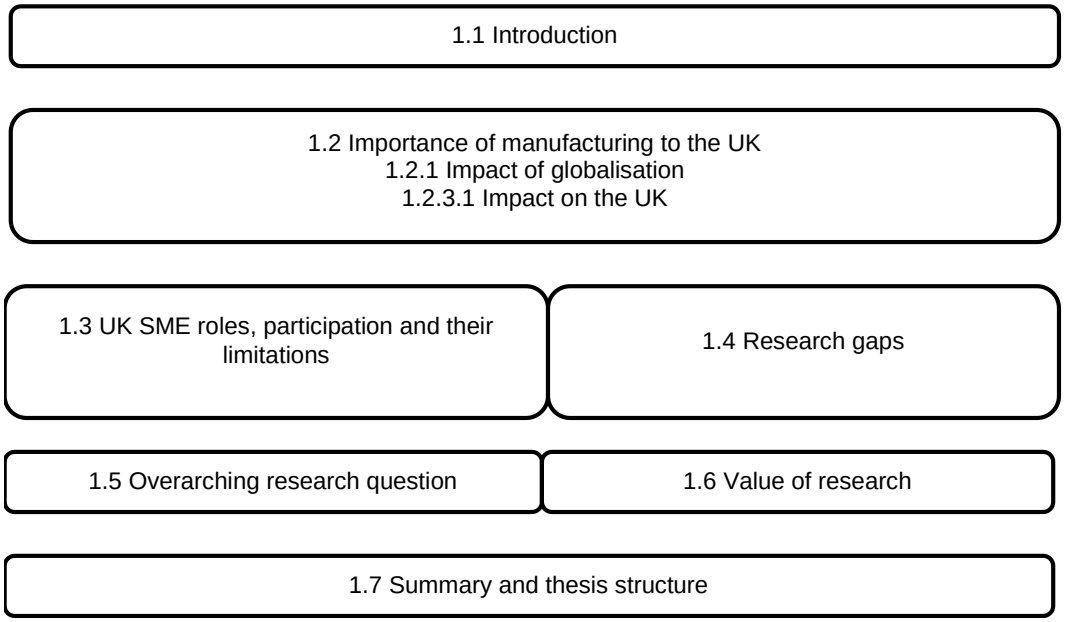
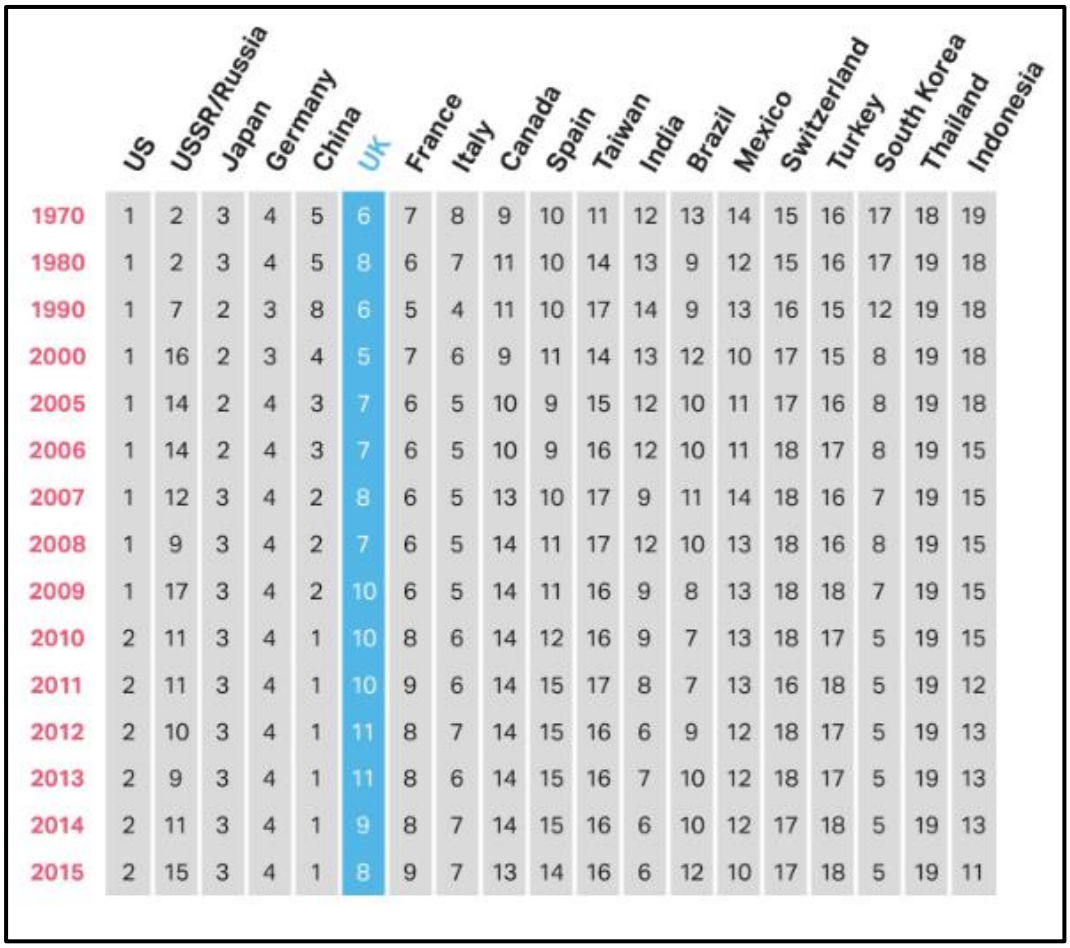


Figure 1-1: Structure of Chapter 1

1.2 Importance of manufacturing to the UK

Manufacturing has a pivotal role in the UK economy, contributing to significant growth in term of gross domestic product (GDP), gross value added (GVA) and employment. In 2009, manufacturing was the third largest sector in the UK in terms of GDP share after business services and the retail sector.



	US	USSR/Russia	Japan	Germany	China	UK	France	Italy	Canada	Spain	Taiwan	India	Brazil	Mexico	Switzerland	Turkey	South Korea	Thailand	Indonesia
1970	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1980	1	2	3	4	5	8	6	7	11	10	14	13	9	12	15	16	17	19	18
1990	1	7	2	3	8	6	5	4	11	10	17	14	9	13	16	15	12	19	18
2000	1	16	2	3	4	5	7	6	9	11	14	13	12	10	17	15	8	19	18
2005	1	14	2	4	3	7	6	5	10	9	15	12	10	11	17	16	8	19	18
2006	1	14	2	4	3	7	6	5	10	9	16	12	10	11	18	17	8	19	15
2007	1	12	3	4	2	8	6	5	13	10	17	9	11	14	18	16	7	19	15
2008	1	9	3	4	2	7	6	5	14	11	17	12	10	13	18	16	8	19	15
2009	1	17	3	4	2	10	6	5	14	11	16	9	8	13	18	18	7	19	15
2010	2	11	3	4	1	10	8	6	14	12	16	9	7	13	18	17	5	19	15
2011	2	11	3	4	1	10	9	6	14	15	17	8	7	13	16	18	5	19	12
2012	2	10	3	4	1	11	8	7	14	15	16	6	9	12	18	17	5	19	13
2013	2	9	3	4	1	11	8	6	14	15	16	7	10	12	18	17	5	19	13
2014	2	11	3	4	1	9	8	7	14	15	16	6	10	12	17	18	5	19	13
2015	2	15	3	4	1	8	9	7	13	14	16	6	12	10	17	18	5	19	11

Figure 1-2: World manufacturing rankings by output, 1970 - 2015, based on shares of top 19 countries in global manufacturing (adapted from Marsh, 2017)

Manufacturing accounted for more than 11% of the UK GVA and 8% of the UK employment (Department for Business Innovation & Skills, 2010). In 2015, UK manufacturing managed to reposition itself back into the eight largest manufacturers in the world, a position it had last reached in 2008 (Figure 1-2 Marsh, 2017)).

1.2.1 Impact of globalisation

The significant contributions of manufacturing could not have been achieved without globalisation. Globalisation is not new, although it was popularised in the late 20th century (Gereffi *et al.*, 2001). Driven by globalisation, advances in technological development and economic liberalisation, manufacturers are able to separate manufacturing activities and perform the activities in different geographical locations (Department for Business Innovation & Skills, 2010).

Advances in information communication technologies (ICTs) and improvements in transport technologies and infrastructure have lowered the cost of sharing and accessing information, and moving and trading goods and services, enabling the development of a global manufacturing footprint (Sainsbury, 2007; UNCTAD, 2010). In addition, trade liberalisation and open economic policies have enabled developing countries to access international markets and increased competition (OECD, 2007; Sainsbury, 2007). Manufacturing, logistics and marketing activities were reorganised around core competencies to leverage location advantages (Abonyi, 2005). Furthermore, subcontracting opportunities have led to a shift in activities from the US and UK to Asia. This has had a significant impact on the competitiveness of individual countries and the role they play in the global manufacturing landscape. As a consequence, new markets such as Brazil, Russia, India and China (BRIC) have emerged as their economies benefit from their new-found wealth.

1.2.1.1 Impact on the UK

As globalisation has intensified, competition in the manufacturing sector has increased. UK manufacturing has faced competition from its major competitors with similar resources and capabilities (e.g. France, Germany, US and Japan) across a broad range of sectors (e.g. aerospace, chemicals and pharmaceuticals). In addition, the UK has faced intense competition from other developing economies, especially BRIC countries, which have been steadily developing manufacturing capabilities (Department for Business Innovation & Skills, 2010). For the UK to benefit from the opportunities of globalisation, UK manufacturers need to differentiate themselves from emerging economies through the development of new, more sophisticated and better quality of products (Sainsbury, 2007; Department for Business Innovation & Skills, 2010).

In 2012, the German Government unveiled their updated manufacturing strategy. At its core was the concept that the world was on the cusp of the 4th industrial revolution, as the rapid development of cyber-physical systems would fundamentally change the manufacturing landscape. Advanced technologies such as additive manufacturing (3D printing), sensors, biotechnology, advanced and autonomous robotics, and cloud computing, will help manufacturers and SCs to be

faster, more responsive and closer to customers (Foresight, 2013). This was evident when manufacturers revealed in a survey that additive manufacturing had given several benefits to them in terms of flexibility of production (54%), reduction in production costs and cycle time (46%) as well as improvement in accuracy (38%) and others (Hennik Group, 2017).

Moreover, Industry 4.0 has also provided an opportunity for UK manufacturing to position itself back as a global centre for advanced manufacturing. In a survey conducted by KMPG, the majority of manufacturers (56%) were confident that Industry 4.0 could bring unprecedented opportunities for the UK to revitalise its manufacturing. Surprisingly, the survey revealed that mid-sized companies were more confident than large companies in terms of having a coherent strategy for Industry 4.0. Mid-sized companies also have more belief than large companies that Industry 4.0 can bring a major impact to companies (KPMG, 2017). This is a sign that SMEs are ready to take advantage of industrial revolution. The integration of IT and industrial production will enable SMEs to share real time data with customers and improve the overall efficiency of the whole system (BDO, 2016, 2018).

The advent of Industry 4.0 could provide greater opportunities for SMEs to be involved in HVM SCs. HVM, which was introduced by the UK Government, aimed to move away traditional manufacturing towards high value products, services and industries (Technology Strategy Board, 2012). The Technology Strategy Board (TSB) (2012, p.3) has viewed HVM as:

> *"… The application of leading-edge technical knowledge and expertise to the creation of products, production processes, and associated services which have strong potential to bring sustainable growth and high economic value to the country. The activities range from R&D to recycling and (it) combines high R&D and high growth to make the sector high value."*

This definition implies that HVM involves current features of modern manufacturing in which the activities are not only limited to production but to a broader range of manufacturing activities such as research and development (R&D), design and skills. It is argued that the roots of HVM lie in Porter's (1985) value chain model.

The idea of a value chain is viewed from the internal perspective of a firm where Porter described a sequence of value-adding activities to convert the raw materials into products. Such activities can be broken down into primary activities (e.g. inbound and outbound logistics, operations, marketing and sales) as well as secondary activities (e.g. procurement, human resource management and infrastructure). Value then can be generated by the firm from any activities and product becomes value when customers are willing to pay for it (Schary and Skjott-Larsen, 2001).

The TSB has classified HVM industry sectors based on R&D intensity as well as sectoral growth, as presented in Figure 1-3. These sectors were identified based on global market size and growth, UK companies' market share and their strength in that sector, profitability, efficiency in generating value and technical intensity. As such, these sectors, which have been classified as being the more 'attractive' in generating wealth to the UK economy, were chosen as the basis for identifying companies participating in this study because they form the official list from the UK government (TSB, 2012).

Figure 1-3: Sectoral attractiveness (adapted from TSB, 2012)

For HVM to create competitive advantage, an individual firm's value chain should be connected to its supplier's value chain as well as the customer's value chain. This implies the concept of an extended value chain. This is more commonly known as the supply chain (SC). The term SC was first formally recognised by Oliver and Weber (as cited in Godsell, 2008, p.20), consultants at Booz Allen Hamilton. It is a term for which academics have failed to achieve a consensual definition (Burgess, Singh and Koroglu, 2006). It is also a term that has provoked much debate around alternatives. The reality of SCs is more complicated than the term suggests. They are not linear chains, but complex interconnected networks (Peppard and Rylander, 2006). In the contemporary world they should be pulled by customer demand (Jüttner, Christopher and Baker, 2007) not supply push. Furthermore, given that their ultimate aim is to deliver value to the customer, is the term "value chain", not more appropriate (Hines, 1993).

Despite the many academic alternatives, Durisova (2013) found that practitioners prefer the term "supply chain". Whilst they understand that academics may strive for a more accurate representation in words, the industry is still trying to embed the basic concepts in practice. Changing the term just adds to the confusion, hence despite its inaccuracies "supply chain" is their preferred term. From the numerous meta studies that have been conducted of the term, there has been enduring acceptance of the definition of Mentzer *et al.* (2001, p.4) who defines an SC as:

"A set of three or more entities (organizations or individuals) directly involved in the upstream and downstream flows of products, services, finances, and/or information flow from a source to a customer."

This definition includes both a customer, focal firm (usually a large manufacturer) and a supplier. This study, therefore, focuses on the relationships between the supplier, which typically will be viewed as an SME, and its buyer, or customer which is larger than the SME in terms of size. Given the positive outlook of global manufacturing, there is significant potential for SMEs to contribute to the UK economic growth by increasing their participation in larger customers' SCs.

1.3 UK SME roles, participation and their limitations

In comparison to traditional manufacturing, whereby production was done in a single large factory, current manufacturing SCs involve a complex network that consists of multiple tiers of suppliers in the chains, including SMEs. The current market involves different types of firms with leading brand companies dominating the market and supported by a multitude of suppliers from domestic and international markets. For example, Nestlé in the food industry, Volkswagen in automotive and Zara in apparel.

Despite the global economy being managed by multinational enterprises (MNEs) and lead firms, SMEs are not entirely absent in the manufacturing SCs as they appear as lower tier suppliers. SMEs provide support to the manufacturing SCs through different roles from supplying input or intermediates, to providing standardised or bespoke product or service to LEs in the SCs (Kaplinsky and Readman, 2001; Jamieson *et al.*, 2012). In some situations, SMEs may participate in the market by being involved in R&D partnerships with larger businesses or providing a niche product or service which larger companies do not have the ability to provide themselves (Jamieson *et al.*, 2012).

Despite the significant roles played by SMEs in the manufacturing SCs, their participation is rather low. In the UK, SMEs accounted for 99.3% of all businesses, 60% of employment and 52% of turnover at the start of 2018. However, in looking into the distribution of SMEs across sectors, manufacturing's share in terms of businesses is less significant than other industry sectors for the start of 2018, as illustrated in Figure 1-4. Although the share of manufacturing was small in terms of the number of businesses, it was still one of the main sectors in the UK in terms of employment and turnover. Nonetheless, in comparison to EU28 members, manufacturing in the UK still showed a smaller role, accounting for 15%, 7% and 13% in terms of employment, businesses and value added respectively (Muller *et al.*, 2017). Worsening the problem, it has been seen that there is a lack of UK suppliers in some of the HVM sectors. For example, UK manufacturers only supply half of the UK demand for the manufactured parts in high value areas, such as automotive, aerospace and pharmaceuticals (Department for Business Innovation & Skills, 2015).

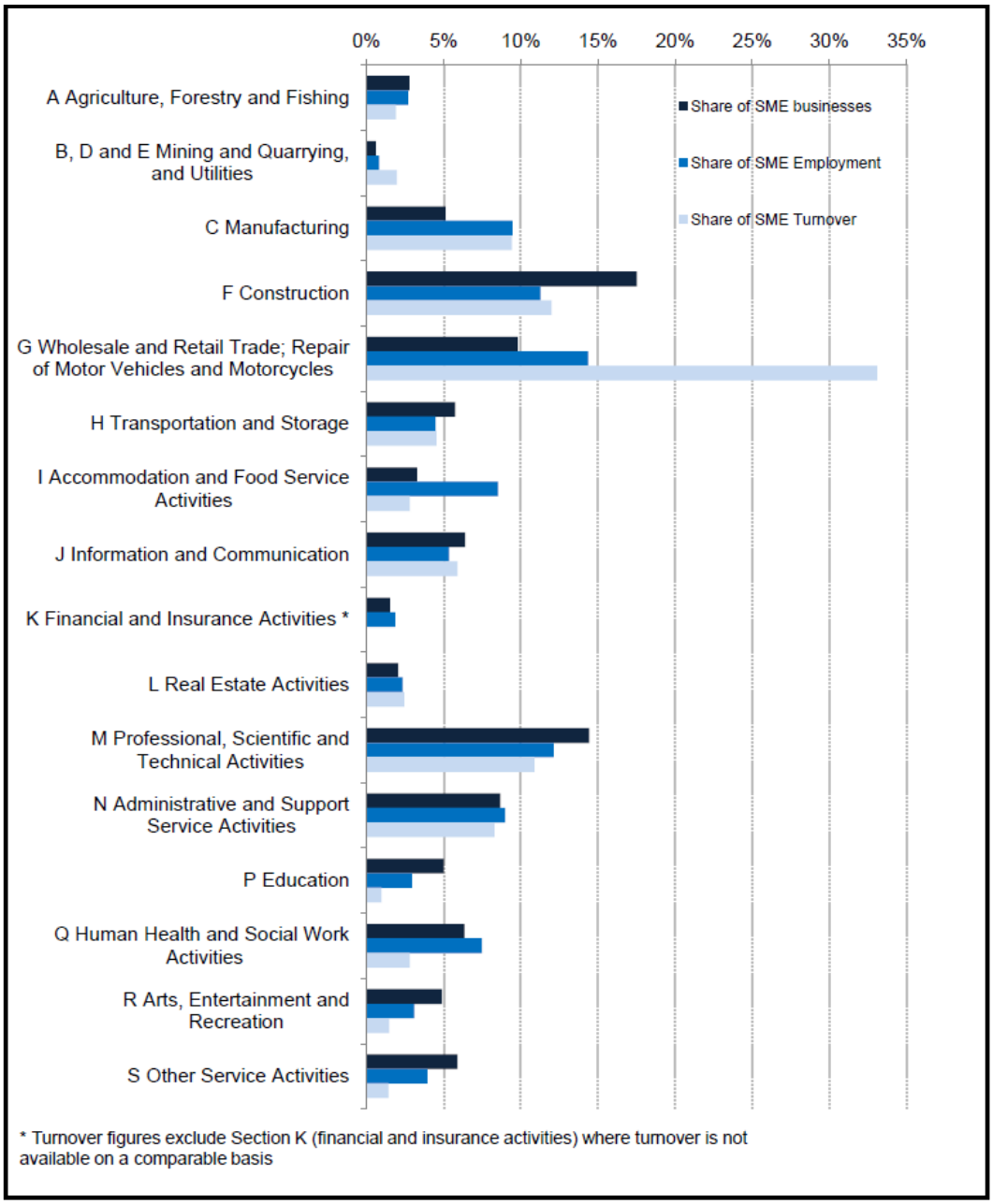


Figure 1-4: Share of SME numbers, SME employment and SME turnover by industrial sector, at the start of 2018 (adapted from Department for Business Energy and Industrial Strategy, 2018)

To strengthen UK manufacturing SCs, it is important to increase SMEs' participation in larger customers' SCs as this yields substantial benefits either on a macro level such as safeguarding jobs, or micro level such as retaining market share of the SME companies. While the contributions for SMEs' manufacturing are large, so too are the issues faced by the SME manufacturers. As illustrated in Figure 1-5, the most pressing issues faced by the SMEs in trade and services and manufacturing in 2017 were finding customers, availability of skilled staff and

experienced managers, competition, costs of production or labour, regulation, access to finance and other. Finding customers was the most pressing problem for SME manufacturers. This was a particular issue in the UK and accounted for 29% of pressing problems. Finding customers was not only a difficulty for UK SMEs but also for other EU28 members, for example Ireland, Spain, Germany, Austria.

Finding customers has been a critical issue among SME manufacturers over a prolonged period. In 2006, Barnes, Chakrabarti and Palihawadana reported that UK SMEs in healthcare manufacturing had a major issue in finding the right distributors or agents to undertake exports. In another study, Crick (2007) highlighted the problem of locating or obtaining adequate representatives as one of the barriers for SMEs' internationalisation. This was also highlighted by Simon Blagden, a non-executive chairman at Fujitsu in Ireland. He identified deficiencies in networking and partnering with LEs as one of the obstacles for SMEs to succeed. LEs such as Fujitsu need to provide support to smaller companies by giving guidance and exchanging experience (Nair, 2012). Parallel to this, the European Commission reported that this issue has remained the most challenging problem since 2009 (European Commission, 2017). A report by the OECD (2009) highlighted the difficulty of SMEs in finding potential customers in foreign markets. The ability to find potential customers, coupled with the knowledge to identify the best ways to enter new markets, are thus critical enablers for the internationalisation of SMEs.

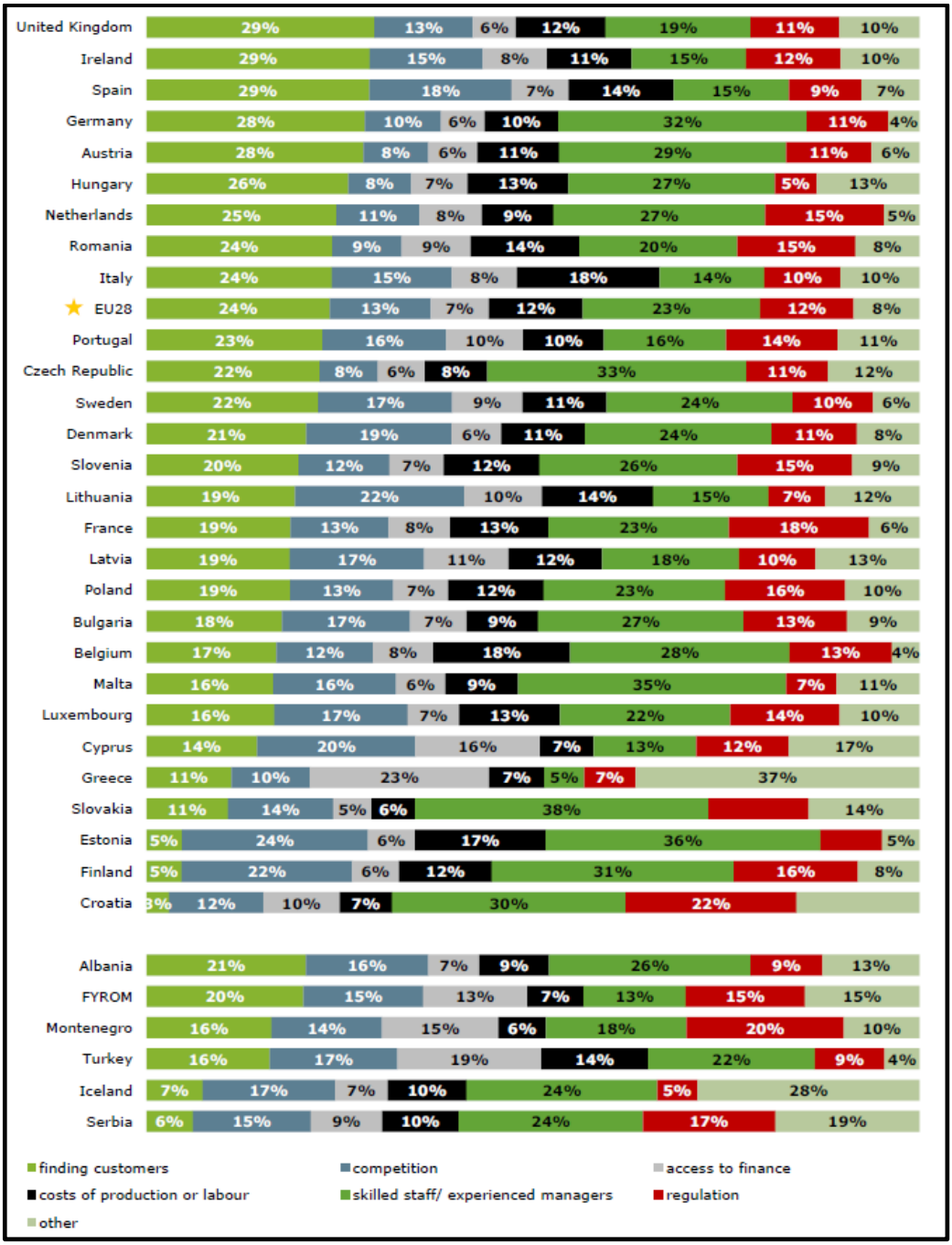


Figure 1-5: Most pressing problems in the six months from April to September 2017 for SMEs (adapted from European Commission, 2017)

Skilled staff/experienced managers shared second place as the most urgent problem experienced by the UK SMEs, accounting for 19%. This problem was recorded by other major countries, such as Germany, Austria, Hungary and the Netherlands. Other pressing challenges of competition, regulation and costs of production or labour were relatively less important for UK SMEs, accounting for just over 10%. SMEs in the UK also had fewer issues in obtaining finance

(European Commission, 2017). It was also reported by the Department for Business Innovation & Skills (2015) that access to finance was not seen as a critical issue in the UK compared to issues such as skills or innovation.

The obstacles for SMEs to grow their business in larger customers' SCs do not come mainly from internal factors but also from external factors. Respondents in research conducted by ORC International[1] reported that the difficulties faced by SMEs in the UK were largely due to external rather than internal factors. Furthermore, larger businesses could be seen as hampering the growth of SMEs creating cash flow problems, bureaucracy and pressure to cut costs (Jamieson *et al.*, 2012). Bureaucracy has hampered the growth of SMEs as they need to comply with the procurement and audit procedures of different customers. Another concern was the increasing pressure from larger customers to drive costs down, which provided more opportunities for countries such as Eastern Europe due to cheaper labour costs.

1.4 Research gaps

Recognising the above limitations faced by SMEs, it is necessary to understand how SMEs (suppliers) can interact effectively with their larger customers (buyers). This is important as SMEs do not always understand potential larger customers' requirements while large businesses are sometimes unaware of SMEs' capabilities (Department for Business Innovation & Skills, 2015). Effective interaction between SMEs and their larger customers is therefore vital to strengthen UK HVM SCs as fragile UK suppliers can lead large businesses to source from overseas due to loss of key skills and know-how among local suppliers.

A significant and growing body of literature has investigated buyer-supplier relationships. A study by Terpend *et al.* (2008) showed the evolution of buyer-supplier relationship studies in four prominent US-based academic journals[2] from

[1] The research was conducted by ORC International in conjunction with Durham Business School. The research was commissioned by the Department of Business, Innovation and Skills' (BIS) Enterprise Directorate.

[2] Journal of Supply Chain Management, previously known as International Journal of Purchasing and Materials Management, Journal of Operations Management, Strategic Management Journal and the Academy of Management Journal.

1986 to 2005. This study shows that operations management (OM) researchers have four primary variables of interest which can be broken down into operational performance value, integration-based improvements, supplier capability and financial performance. As this study focused on achieving effective interaction between SMEs and their larger customers, integration-based and capability-based value literature are of interest.

In looking into integration-based value studies, the majority have focused on improved collaboration. These include practices that can promote collaborative relationships between buyer and supplier, and factors to improve collaboration, cooperation and partnership, which focus on the performance improvements resulting from collaboration. Although these studies focus on integration between buyer and supplier, the studies only attempt to examine the effects of various integration practices on the buyer's financial performance (Ellram *et al.*, 2002; Droge, Jayaram and Vickery, 2004; Petersen, Ragatz and Monczka, 2005; Terpend *et al.*, 2008). Besides integration-based value, there are also an increased number of papers related to supplier capability-based improvements in the buyer-supplier relationships. Unfortunately, these studies tend to focus on the benefits that buyers could obtain from their suppliers' capabilities; in particular these studies explored the suppliers' capabilities that were demanded by buyers (Terpend *et al.*, 2008). For example, Nicholls-Nixon and Ivey's (2003) study found that firms could generate new technical output by building it using suppliers' technical capability.

A large number of studies have also been published concerning the capabilities that are required by firms to achieve competitive advantage. However, these studies only attempt to examine the capabilities possessed by larger firms (Teece, Pisano and Shuen, 1997; Teece, 2014) or to a greater extent, they focus on intra-firm capabilities (Grant and Baden-Fuller, 1995; Nonaka and Takeuchi, 1995; Teece *et al*., 1997). Teece (2007, 2014) stated that enterprises with dynamic capabilities are highly entrepreneurial and have a hierarchical organisational structure but that SMEs do not have these. Moreover, most research on dynamic capabilities have focused on established companies rather than SMEs or new ventures (Zahra, Sapienza and Davidsson, 2006). In other studies, Grant (1996b) highlighted the importance of integrating knowledge within members of an organisation to build distinct organisational capability, whereas Nonaka and

Takeuchi (1995) focused on the ability of the organisation to generate knowledge within its firm as knowledge has been considered as the lasting source of competitive advantage. These studies have shown that prior research has given more attention to intra-firm capabilities and LEs.

To address this gap in the literature, this study adopts the interaction capability framework by Johnsen and Ford (2006), which emphasises SMEs with reference to their relationships with larger customers. In this study, the interaction capabilities framework was selected for three reasons. Firstly, the framework emphasises relationship-specific properties. Unlike previous work that focused solely on firm-specific properties, interaction capabilities address relationship-related properties by addressing the relationships between small suppliers and larger customers as the centre of the research. As the study focuses on the context of the HVM SCs, relationship-specific properties may be relevant to study the relationships between SMEs and their larger customers. Secondly, the framework focuses on firm-level capabilities but still emphasises the inter-firm capabilities, rather than intra-firm capabilities. Thirdly, the framework focuses on capabilities possessed by suppliers. As prior research on interaction capabilities has tended to be case study based (Johnsen and Ford, 2006; Johnsen and Tseng, 2010; Ngugi, Johnsen and Erdelyi, 2010; Cui and Hertz, 2011; Talay and Dean, 2012), this study extends the body of interaction capabilities by adopting an alternative methodological approach, i.e. a survey.

1.5 Overarching research question

Several studies have been published discussing the importance of interaction capabilities among small suppliers in relationships with larger customers (Johnsen and Ford, 2006; Johnsen and Tseng, 2010; Cui and Hertz, 2011; Talay and Dean, 2012). Previous research has also explored the importance of interaction capabilities on innovation (Ngugi *et al*., 2010). However, no previous study attempts to empirically demonstrate the relationships among interaction capabilities, SMEs' participation and their firm performance.

This study is important as effective interaction between SMEs and their larger customers has a considerable influence on SMEs' participation in larger

customers' SCs. The Department for Business Innovation & Skills (2015) highlighted that poor communication and collaboration between suppliers and their customers have caused market failure. An information gap has caused suppliers to be insufficiently aware of future demand, while larger customers are inadequately aware of the right suppliers. This study, then, adopts a framework of interaction capabilities and explores their roles in increasing SMEs' participation in larger customers' SCs. Interaction capabilities can be seen as vital in this context of study as they assist SMEs to manage their relationships with larger customers who are at the top of an SC. These customers can be the ones who stimulate or impede the growth of their suppliers. This study also demonstrates that SMEs who increase their participation in larger customers' SCs will improve their firm performance. This research is not only important, but it is necessary in order to advance the field of interaction capabilities. This study, therefore, attempts to empirically answer the following overarching research question:

"What are the role of interaction capabilities in increasing SMEs' participation in larger customers' SCs and improving their firm performance?"

1.6 Value of research

The findings of this study will bring benefits to the UK economy, considering that manufacturing, particularly HVM, plays an important role in providing opportunities for businesses to succeed in the long-term. HVM sectors have been identified by the UK Government to generate growth and high economic value to the UK. In order to achieve this, SMEs need to increase their participation in larger customers' SCs as manufacturing is made up of smaller businesses. However, some SMEs have had problems in growing their business with larger customers. Thus, the results of the study will provide insights into the capabilities that are required by SMEs to interact effectively with their larger customers. The input of this research will guide SMEs on which capabilities they should focus on in order to grow their businesses in conjunction with larger customers.

1.7 Summary and thesis structure

In this chapter, the issues and problems of the study are presented by establishing the context of the UK manufacturing, particularly the HVM, industry. Following the issues of manufacturing SMEs, the overarching research question was presented to address the research gap found in the literature. Then, the chapter continued by discussing the importance of this research. The remaining chapters have been organised in the following way. Chapter 2 examines the existing literature related to interaction capabilities, participation and firm performance on which a conceptual framework is generated. Chapter 3 discusses the philosophical stance guiding the research and justification for the methodological approaches adopted. The chapter also details the measures, data collection procedures and ethical considerations, followed by Chapter 4 which presents the model development in which hypotheses are proposed. The subsequent chapters, Chapters 5, 6 and 7 present the results and data analysis of the scale development, survey questionnaire and case study accordingly. Further to data analysis, discussions of findings from both qualitative and quantitative empirical works, are presented in Chapter 8. The final chapter, Chapter 9 offers a conclusion and provides the contributions to research, limitations and recommendations for future work. Figure 1-6 presents the structure of the thesis.

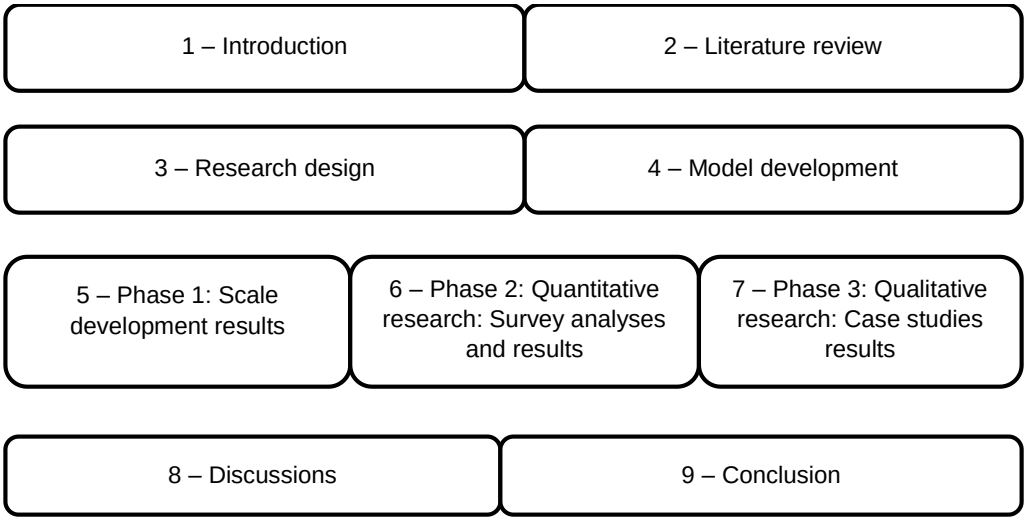


Figure 1-6: Structure of the thesis

2 LITERATURE REVIEW

2.1 Introduction

This chapter is structured around three central points as depicted in the proposed conceptual framework (Figure 2-1). The chapter begins by exploring the literature related to interaction capabilities, which pertain to the capabilities that are required by SMEs to interact effectively with larger customers (Section 2.2). In Section 2.2, capabilities literature is explored first before introducing four types of interaction capabilities. The chapter continues with forms of participation in Section 2.3. Section 2.3 also identifies three ways that enable SMEs to grow their share with larger customers. In Section 2.4, the chapter determines different measures of firm performance. The chapter concludes in Section 2.5 with a summary.

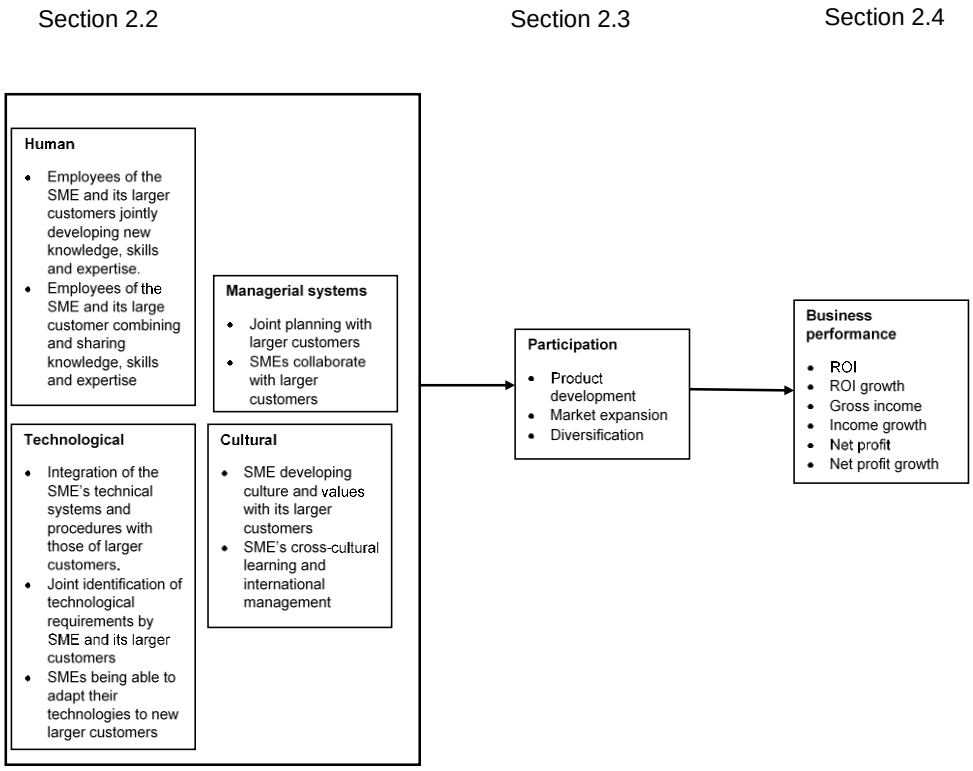


Figure 2-1: Conceptual framework of role of interaction capabilities to increase SME participation in larger customers' SCs

2.2 Towards Interaction capabilities

In any organisation, resources and capabilities are deemed to be important in helping the organisation to achieve competitive advantage. According to the resource-based view (RBV), firms are able to achieve above-normal returns through resources and capabilities that are valuable, rare, inimitable and non-substitutable (VRIN) (Barney, 1991). Resources and capabilities are needed to carry out activities or to produce goods or services. Resources are inputs to production, either tangible or intangible, that are owned or controlled by an organisation, or it has access to on a semi-permanent basis (Helfat and Peteraf, 2003). Amit and Schoemaker (1993, p.35) defined resources as *"stocks of available factors that are owned or controlled by the firm".* Unlike resources in which most organisations share common types of plants, technology, machinery and buildings, capabilities are different. Capabilities cannot be bought or sold as resources because they require an organisation to develop, as they are the enablers for what the organisation could accomplish (Teece, 2014).

As Makadok (2001) indicated, capability is embedded in an organisation. Ownership of a capability cannot easily be transmitted from one organisation to another without owning the organisation itself or a self-contained subunit of the organisation. Makadok distinguishes between capability and resources through two key features. Firstly, the firm's capability is specific as it is embedded in the firm or its processes, while an ordinary resource is not. Secondly, the key purpose of capability is to increase the productivity of other resources' productivity that is possessed by the firm. Thus, capabilities between organisations differ, depending on the efficiency of those organisations.

The concept of capability consists of a set of routines in which, for it to be a capability, it must reach a minimum threshold level of routine activity. This means an organisation only possesses a capability when it meets some minimum level of functionality that allows repetition and reliable performance of an activity (Helfat and Peteraf, 2003). In turn, capabilities refer to the capacity of a firm to deploy resources using organisational processes to produce a desired outcome (Amit and Schoemaker, 1993). Capabilities are firm-specific and developed as the result of

complex interactions and coordination between firms' resources (Amit and Schoemaker, 1993; Colotla, Shi and Gregory, 2003).

A large volume of published studies has explored the concept of capability from many perspectives, in an attempt to explain the different degrees of organisational success. They include core capabilities (Leonard-Barton, 1992), knowledge capabilities (Nonaka and Takeuchi, 1995; Grant, 1996a; Nonaka, 2007), dynamic capabilities (Teece *et al*., 1997; Teece, 2007, 2012, 2014) and network capabilities (Shi and Gregory, 1998; Miltenburg, 2005) within which some have been developed around the RBV.

Although there is a large amount of knowledge around capabilities, this cited literature is mainly concerned with intra-firm capabilities and their contributions to a firm's performance and competitive advantage. For example, knowledge-based capabilities have been studied in various dimensions (Nonaka and Takeuchi, 1995; Grant, 2015). The literature suggests that a firm's competitive advantage depends on the ability of the firm to integrate specialised knowledge among its organisational members (Grant, 1996a, b). Similarly, Nonaka, (2007) differentiated between a successful organisation and an unsuccessful one on the ability of the organisation to generate new knowledge, disseminate it within the organisation and embody it in products, services and systems. Further, the literature reveals that a key distinctive way for an organisation to innovate is in its knowledge creation (Nonaka and Takeuchi, 1995).

The focus of intra-firm capabilities has also appeared in Leonard-Barton's (1992) work, which examined the nature of a firm's core capability that includes a collection of knowledge sets. Leonard-Barton argued that these capabilities encompassed knowledge and skills, technical systems, managerial systems, and values and norms that enabled products/processes development. She emphasised that an understanding of core capabilities is important as at the same time as they enable innovation, they can also impede it.

While core capabilities focus on a firm's ability to enhance innovation, dynamic capabilities focus on the ability of a firm to deliver products quickly to market. Dynamic capabilities have been developed as an extension of the RBV, claiming

that a firm's success is no longer based on resources such as technology assets but on how quickly products can be in the dynamic market to meet customers' requirements. The concept has been emphasised within two key dimensions: dynamic and capabilities. Dynamic implies the capacity of a firm to renew competences so as to achieve congruence with the changing business environment, whereas capabilities refer to the key role of strategic management in appropriately adapting, integrating and reconfiguring internal and external organisational skills, resources and functional competences to match the requirements of a changing environment (Teece *et al*., 1997). The literature also suggests that firms possessing both idiosyncratic resources/competences and strong dynamic capabilities make sustained competitive returns through unique products provided to the buyer (Teece 2007, 2014).

Another debate of concern is that previous studies on dynamic capabilities largely focus on more established companies rather than SMEs and new ventures, as reported by Zahra *et al*. (2006) in Table 2-1. In addition, recent studies on dynamic capabilities have also revealed that some studies still focus on LEs (Kim *et al.*, 2011; Caniato, Golini and Kalchschmidt, 2013).

Table 2-1: Overview of past research on dynamic capabilities (adapted from Zahra *et al.*, 2006)

Variable	New ventures	Established companies
Nature	George *et al.* (2004)	Eisenhardt and Martin (2000); Winter (2003); Geiger and Kliesch (2005)
Antecedents	Arthurs and Busenitz (2005)	Wheeler (2002); Zollo and Winter (2002); Blyler and Coff (2003); Verona and Ravasi (2003); Korr and Mahoney (2005)
Process	George *et al.* (2004)	Zollo and Winter (2002); Lampel and Shamsie (2003); Salvato (2003); George (2005); Lazonick and Prencipe (2005); Mosey (2005)
Outcome	Arthurs and Busenitz (2005); Newbert (2005); Sapienza *et al*. (2006)	Eisenhardt and Martin (2000); Zahra and George (2002); Blyler and Coff (2003); Verona and Ravasi (2003); Bowman and Ambrosini (2003); George (2005); Lazonick and Prencipe (2005); Lenox and King (2004)

There is an implicit assumption that the bias of dynamic capabilities studies towards LEs is due to the concept itself being more relevant to LEs. The concept suggests that this capability is more likely to be resident with individual managers or top management in firms with high entrepreneurial, flat hierarchical

organisational structures that have a clear vision, high-powered incentives and high autonomy (Teece, 2007, 2014). Usually, SMEs do not have these advantages. In a similar vein, Shi and Gregor (1998) proposed network capabilities that are particularly suitable for multinational corporations (MNCs) thus ignoring SMEs. The capabilities have focused on a firm with operations beyond the domestic market, specifically international markets in which not all SMEs have the opportunity to operate.

Although prior research has highlighted that capabilities are developed through complex interactions (Amit and Schoemaker, 1993; Colotla, Shi and Gregory, 2003), it is evident it has given less attention towards inter-firm capabilities. Interaction involves processes through which a relationship is built, developed, maintained and terminated. It includes intra- or inter-firm acts that are carried out within and by the focal firms forming an exchanging relationship (Möller and Wilson, 1995b). Prior to determining that any relationships can be established, an interaction process has to take place. Through business relationships, capability can be developed by connecting the various resources of two companies (Hakansson and Snehota, 1995).

Within firms, there are a number of activities that occur which require different types of resources, such as a manufacturing plant, human expertise/knowledge and technical systems (Ford, Hakansson and Johanson, 1997). These resources cannot be treated as a stand-alone asset because each resource takes its own value through a combination with other resources (Gadde, Hakansson and Persson, 2010). Thus, the interaction between firms that have changed these resources from passive to active and from being fragmented to being integrated, lead the firms to perform the activities.

The key success for SMEs to be working in the LE's SC is to build upon the advantages of building relationships and minimise the differences between firms that may have different business objectives. Studies have shown that buyers do not assess the performance of suppliers based on technical or commercial skills, but on their capability at building relationships (Ford, 1980). Although the firm may have a major source of competitive advantage such as knowledge, this source will be worthless without combining it with other firms' resources. The interaction

makes the knowledge valuable for the other party's transactions because either the supplier or buyer seeks a partner for the exploitation or enhancement of their resources. Interaction happens because of interdependencies of companies in which those interdependencies are based on the need to use the knowledge and abilities of others to deliver a form of goods or services (Turnbull, Ford and Cunningham, 2016).

Managing the buyer-supplier relationships can be seen as vital, especially for SMEs to grow their share with larger customers. The management of business relationships is not straightforward but complex, as it combines different sets of human skills, technical systems, management, diverse language and dissimilar cultures, which can hinder effective buyer-supplier relationships. Although the business relationships are complex, they posit positive effects on the development of technical competence as well as company capacity. Relationships are important for the business as capability development is influenced by interactions within business relationships. A company's capability is reflected in its success in combining relationships with others (Hakansson and Snehota, 1995). Thus, it is necessary to understand capabilities that are developed through interactions as this enables both buyer and supplier to generate above normal rates and sustain competitive advantage.

In addition, there is an increased amount of research that demonstrates the need to build supplier capability in manufacturing SCs (Jamieson *et al.*, 2012; Department for Business Innovation & Skills, 2015). Despite extremely innovative and agile SME manufacturers, a large number of SMEs still need support to achieve their full potential. In a HVM SC, there are some industry sectors that are fragile as they are dominated by SMEs with financial constraints. In other cases, some SMEs have difficulty in collaborating with LEs (Department for Business Innovation & Skills, 2015). Here, there is an opportunity to explore interaction capability in helping SMEs to grow their share with larger customers.

Prior studies have examined types of interaction capabilities developed by small suppliers in relationships with larger customers. The literature proposes a set of interaction capabilities that are important for small suppliers to better manage their relationships with larger customers. In reviewing the interaction capabilities studies

in Table 2-2, it can be seen that prior researchers have studied the interaction capabilities in different contexts and industries, allowing for a richer understanding.

Table 2-2: Studies on interaction capabilities

Authors	Empirical setting	Key constructs
Johnsen and Ford (2006)	Case studies in the UK textile industry	Discusses the types of interaction capabilities developed by suppliers in their relationships with larger customers
Ngugi et al. (2010)	In-depth case studies in the UK organic sector	Discusses the types of relational capabilities developed by SMEs in their relationships with larger customers and the influence on value co-creation and innovation
Johnsen and Tseng (2010)	Case studies in UK manufacturing companies	Discusses the influence of interaction capability development on SMEs' customer relationships
Cui and Hertz (2011)	Case studies in logistics firms	Discusses the development of interaction capability among logistics firms and its influence on logistics innovation
Talay and Dean (2012)	Case studies in small export companies in Turkey	Discusses the development of interaction capabilities among small export suppliers and their influence in relationships with importers

The interaction capability concept was first developed by Johnsen and Ford (2006) and only involved one industry and one country: the UK textile industry. The study was developed to examine interaction capabilities built by small suppliers in relationships with larger customers. The interaction capability framework was predominantly based on the work of Leonard-Barton (1992). Her work focused on firm's capabilities when involved in the development of new products and processing projects which may provide competitive advantage. This set of capabilities is embodied in employee knowledge and skills, and embedded in technical systems. Further, this capability is guided by the managerial systems and deeply rooted in values and norms. Based on this work by Leonard-Barton, Johnsen and Ford (2006) adapted the classification to propose a set of interaction capabilities as relationship-specific properties (Johnsen and Ford, 2006).

Johnsen and Ford (2006) examined the interaction capabilities concept through two stages of in-depth case studies. An in-depth interview process was conducted with the key informants: managing director, director or senior manager in eight companies. All eight cases were either first tier or second tier suppliers of UK textiles and their size was smaller than their larger customers. In the first stage, the study explored the structure of small suppliers in relationships with larger customers. Having established the conceptual framework of interaction

capabilities, as illustrated in Figure 2-2, stage two of the case study investigated the critical aspects of supplier's interaction capabilities and their development in influencing relationships with larger customers. From the case studies conducted, Johnsen and Ford (2006) proposed a four-fold interaction capability, which was found to have an important bearing for SMEs to better manage their relationships with larger customers. Their study has defined the specific elements of smaller suppliers' interaction capability, comprised of human, technological, managerial systems and cultural interaction capability.

Human interaction capability	**Technological interaction capability**
Bilateral development of knowledge by employees of supplier and customer Combined and new areas of knowledge and expertise developed through sharing and intertwining of both firms' knowledge and expertise	Integrated technical systems and procedures across supplier and customer Bilateral identification of technological requirements of each party Supplier's technology and technical systems adaptable to new
Managerial systems interaction capability	**Cultural interaction capability**
Bilateral development of supplier and customer's structures, strategies and relationships Supplier has experience of collaboration with different counterparts in different situations and established techniques to facilitate collaboration Supplier's relationship management approaches to cope with ranges of different counterparts	Bilateral development of supplier and customer's culture and values Supplier has opportunities for cross-cultural learning and development of international management skills through engaging with variety of counterparts in the network

Figure 2-2: Four-fold interaction capability (adapted from Johnsen and Ford, 2006)

Since then, a few articles have been published as part of growing the body of interaction capabilities literature. Table 2-2, shows that four articles have been written within the six years of its development. The authors of these articles using mostly case study methodology, have shown the influence of SMEs' interaction capability in managing customer relationships. Due to the strong influence of inter-firm capability, Johnsen and Tseng (2010) explored the role of interaction capability among UK manufacturing SMEs; they made an attempt to generalise the findings to other situations by including various sectors in manufacturing. In the same year, Ngugi *et al*. (2010) made a contribution by not only exploring the role of interaction capability but also its influence on value creation and innovation. Along with Johnsen and Tseng and Ngugi *et al*., Cui and Hertz (2011) studied the

role of interaction capability in logistics firms and its influence on the logistics process whereas Talay and Dean (2012) investigated the influence of interaction capability within small export suppliers in terms of their export involvement.

Johnsen and Tseng's (2010) work revealed that the type and length of interaction capabilities establishment possessed by the SMEs influenced their relationships with larger customers. The work highlighted that customers were attracted to SMEs with strong and well-established interaction capabilities to participate in the customers' international market. The customers provided opportunities for these SMEs to grow their business with the customers. Similarly, Talay and Dean (2012) reported that interaction capability possessed by the small export suppliers drew importers' attention and offered opportunities for these suppliers to position themselves better in importers' networks. The literature also shows that interaction capability possessed by the SMEs enhanced innovation and their position as preferred suppliers to the larger customers (Ngugi *et al.*, 2010). Ngugi *et al.* (2010) concluded that both SMEs and their larger customers achieve mutual benefits resulting from the effective interaction. Cui and Hertz (2011) found similar interaction capability benefits in which the development of interaction capability guides the logistics innovations within the logistics firms. The literature on interaction capabilities has addressed the fundamental question on how development of interaction capabilities helped SMEs to better manage their relationships with larger customers. To appreciate the contributions of this literature, it is essential to further validate the results in different contexts through different research approaches. This can help the findings to be extrapolated in other settings. The four types of interaction capabilities; HIC, TIC, MIC and CIC are explained in the next sections.

2.2.1 Human interaction capability

The first interaction capability is identified as HIC. Knowledge and skills that are embedded in people are considered as a core capability of a firm and mostly associated with new product development (NPD) (Leonard-Barton, 1992). As a core capability of the firm, knowledge has been regarded as an assured source of lasting competitive advantage due to the economic growth and prosperity that it can bring (Teece 1998; Nonaka, 2007). Grant (1996a) indicated that knowledge

transfer and integration are better in networks, either firms or individuals; further, Grant emphasised that through inter-firm collaboration, knowledge integration can be done. Knowledge that is embodied in an individual's skills, expertise and experience is not easily imitated and deployed (Teece, 1998), especially tacit knowledge (Nonaka, 2007) where the knowledge includes firm-specific techniques and scientific understanding (Leonard-Barton, 1992). According to Moreira (2009), the base of knowledge is critical to both suppliers and customers. From a customer perspective, the aim is to stimulate change to ensure suppliers can meet specifications and compete in international markets using best practices. For suppliers, however, developing a learning strategy is the focus in order to add value to their relationship with customers as well as to secure their position in the international SC.

HICs can be developed through the development of new knowledge, skills and expertise by employees, small suppliers and larger customers (Johnsen and Ford 2006). In the early stage of the relationships, the main focus of SMEs is typically on the development of internal staffs' skills, expertise and knowledge (Johnsen and Tseng, 2010). Learning orientations may be important for these SMEs as they involve organisations' activities such as knowledge creation and application (Calantone, Cavusgil and Zhao, 2002). Nonaka (2007) identified four basic forms of generating knowledge within the organisation so as to distinguish between tacit and explicit knowledge. The process, which is known as the spiral of knowledge, involves tacit to tacit, explicit to explicit, tacit to explicit and explicit to tacit knowledge. In interactions between suppliers and customers, the exchange of explicit knowledge is mostly required and can be accomplished with little collaboration. However, in a situation where both firms engage in order to solve a complicated issue, tacit knowledge will be required as it is likely to reside in both firms (Zacharia, Nix and Lusch, 2011).

Development of knowledge by the employees of suppliers and customers is an important constituent to forge innovation between SMEs and their larger customers. The development of knowledge, skills and expertise is shown through joint knowledge exchanges or development programmes, such as training by suppliers and customers, to facilitate knowledge sharing. The interaction that is developed between both parties enables shared training needs to be identified.

This process seems to benefit both parties as the training structure will meet the needs of SMEs and larger customers (Ngugi *et al.*, 2010). Often, at the early stage of the business, SMEs have limited HIC but have the ability to manage this weakness through interaction with larger customers' top management. On the other hand, SMEs in the competitive international market hire a specialist agent to reduce this weakness but this has been without success (Talay and Dean, 2012).

Combined, or creation of, knowledge can be developed through sharing and linking of both firms' knowledge and expertise (Johnsen and Ford, 2006). Inter-firm knowledge sharing has been highlighted as strategies that should be used by firms in order to gain high profits (Dyer and Singh, 1998). Forming cross-functional and cross-hierarchical teams can be seen as a way to facilitate knowledge exchange. This is highlighted by Grant (1996a), in which cross-functional product development teams can be viewed as having the processes to achieve better integration of a broad span of specialised knowledge. The process of sharing between suppliers and buyers is also called relationship learning (Cheung, Myers and Mentzer, 2010). Cheung and colleagues claimed that relationship learning, as a joint activity between suppliers and buyers in which both parties share information, is critical in influencing relationship value for both supplier and customers in cross-border exchange. SMEs have more scope to combine and share knowledge, expertise and skills with larger customers when relationships are at a mature stage (Ford, 1997). The process of combining and sharing knowledge seems to be hard in the early stage of the relationships and particularly for some small or micro suppliers where creation of knowledge is a challenge to them (Johnsen and Ford, 2006). This is because both suppliers and customers have little experience of each other. Their view of each other is limited to what has been requested and gained from the other party. Nonetheless, this process can be reduced by investing in human resources (Ford, 1997).

The literature review demonstrates that the central idea of HIC is around knowledge. Knowledge embedded in humans is critical for HIC. Development of HIC can be achieved through the joint development of knowledge, skills and expertise between the employees of suppliers and customers. In addition, combining and sharing knowledge between employees of both parties may enhance HIC.

2.2.2 Technological interaction capability

The second is TIC. Often, buyer and supplier interact with each other to utilise the technologies that each does not possess (Thomas and Ford, 1995). According to Leonard-Barton (1992), this capability comprises compilations of knowledge that derive from multiple individuals. These compilations of knowledge can be translated into two types of technological capability: products and processes. A supplier is sought by its larger customer to buy a product, not because it is standard and unremarkable, but due to the distinctive way of production which provides greater consistency in quality. This scenario is highly applicable in the case of the manufacturing industry where SMEs are sought by their larger customers because of the way products/parts/components are designed. The second type of scenario is when a larger customer may appear to buy an SME's product because of the process technology it has. Often, a larger company realises the potential of an SME because it has no production capacity or lacks process technology. Moreover, Ford and Saren (1997) added that a larger customer may seek out an SME not because of either of these two but due to an SME's marketing technology. Marketing technology involves the skills of SMEs in undertaking an analysis of a market, tailoring product and process technologies to meet the requirements of that market analysis, and having skills in logistics, advertising and selling.

It is evident that effective and efficient use of information technology (IT) is a key factor in distinguishing between successful firms and the ones that are not. The effective use of IT, however, is influenced by the IT resources and skills of the firms (Bharadwaj, 2000). Further, Bharadwaj classified key IT-based resources into three: a) tangible IT resources such as physical infrastructure components, b) human IT resources encompassing technical and managerial IT skills, and c) intangible IT resources such as knowledge assets. IT resources which are comprised of IT assets and capabilities can be used to support interorganisational system (IOS) use in collaborations between SC partners (Cao and Zhang, 2013).

Development of TIC by SMEs can be done in many ways. One is through expansion of technical systems and technological innovation of SMEs (Ngugi *et al.*, 2010). Technological innovation is a sequence of actions perpetuated in the business market and is affected by the current structure of the network, such as

actors and their inter-organisational relationships and also the combination of activities and resources (Hakansson and Lundgren, 1995). Within TIC, integration of technical systems among SMEs and their larger customers is important. The integration allows technical problems to be identified and fixed at an early stage. Through integration, opportunities can be created and more technological exchange between both parties can happen (Johnsen and Ford, 2006). Previous studies noted that interaction with clients has frequently enabled them to develop their own IT systems and be able to integrate into larger customers' systems in a better way through modifications and customisation (Cui and Hertz, 2011). However, previous study has also shown that the integration level of SMEs is rather influenced by the demands of the larger customers. For instance, SMEs with highly customised technology will have difficulty working on other relationships (Johnsen and Ford, 2006).

Furthermore, by interacting, joint identification of technological requirements by SMEs and their larger customers can easily take place. This enables both parties to plan and predict any technological developments that might happen (Johnsen and Ford, 2006). This development includes improvement in technical systems and procedures both in the supplier and customer's firms. Hakansson and Lundgren (1995) highlighted that technological development is largely dependent on the technical exchange between different actors in the market. When companies agree to cooperate in a new technological development, issues such as which applications should be approached first or who should take the lead in technological development will be raised (Thomas and Ford, 1995). Previous study has pointed out that larger customers tend to lead the direction when there is a large size difference between suppliers and customers. However, these issues can be resolved through better planning in terms of close communications and relationships with larger customers (Johnsen and Ford, 2006). Involvement in the client's technological development can also take part in the form of exchange in technology knowledge by the supplier (Cui and Hertz, 2011).

TIC also involves the adaptation of technology, which occurs when experience between SMEs and larger customers increases. Through joint technological development, SMEs are more flexible in adapting their technology to new, potentially larger, customer's technology and situations in order to provide a

customised service offering (Johnsen and Ford 2006; Cui and Hertz, 2011). Over time, they can easily adapt their product or process technologies to a wider set of relationships (Johnsen and Ford, 2006). Technological adaptations are comprised of product adaptation as well as production processes (Hakansson and Gadde, 1997). These adaptations, however, are not possible without marketing technology, as different customers have different requirements. Thus, the right marketing strategy is needed to enable them to translate the requirements precisely, and tailor, package and communicate their offerings in order to deliver them to their larger customers at an agreed cost (Ford and Saren, 1997). Talay and Dean (2012) in their study claimed that suppliers who are termed as exporters have difficulty in replacing and changing their existing technologies in the domestic market to adapt to foreign customers.

In conclusion, TIC can be defined as the ability of an SME to open up to technological innovation, combine existing technologies and collaborate on new technological configurations with larger customers. Development of TIC involves integration of technical systems, bilateral identification of technological requirements and technological adaptation by both parties.

2.2.3 Managerial systems interaction capability

The third capability is called MIC which concerns the management of the firm. Ansoff (1968) emphasises that management capability involves the ability of management to make different types of decisions and actions. It is related to the development of structures, strategies and relationships with suppliers and customers (Leonard-Barton, 1992; Johnsen and Ford, 2006). Within marketing, strategy denotes "*a plan to maximise the probability of capturing targeted business through manipulation of controllable factors such as product design, advertising, cost control and market knowledge*" (Morris and Pitt, 1993, p. 44). Plan, objectives, profits, directions, targeting, competition and customer needs are all words usually associated with strategy (Morris and Pitt, 1993).

MIC relates to the development of strategic planning and collaboration between SMEs and customers. Strategic collaboration is essential to align the interests of firms across SC partners. Collaboration between SC partners can be defined as

firms working in a close relationship to achieve common goals and mutual benefits (Cao and Zhang, 2013). Strategic collaboration between buyer and supplier involves information sharing for demand forecasting and strategic planning (Kim and Lee, 2010). Participation of the other party is sought in order to engage in joint planning and goal setting (Mohr and Spekman, 1994).

However, strategic collaboration might be a challenge without systems collaboration between firms due to lack of communication and information sharing (Kim and Lee, 2010). Information sharing is an essential element for collaboration between suppliers and buyers to take place. It is the extent to which a firm shares a variety of relevant, accurate, complete and confidential information at the right time with the other party. Information sharing allows firms to monitor the progress of the products and quick decision-making can then be made.

In any strategic alliance between buyer and supplier, long-term collaborative effort would be the aim of the relationship. This relationship, however, is influenced by several factors, such as goal compatibility, trust, satisfaction, investments, structural bonds, social bonds and comparison levels of the alternatives (Wilson and Jantrania, 1997). Collaborative efforts between firms can be achieved in several forms. These include joint planning between buyer and supplier, such as sharing of information on capacity changes, future product changes or production data to the other party (Johnston *et al.*, 2004). Joint planning is a collaborative activity where future contingencies and subsequent duties and responsibilities are made explicit in the relationships. It acts as a frame of reference rather than strict contract specifications that need to be abided by (Pimentel Claro and Oliveira Claro, 2010). Samson and Terziovski (1999) added that the emphasis of strategic planning on customer driven quality and operational performance excellence is essential for overall business planning due to key strategic issues. Through joint planning, mutual expectations can be established and collaborative efforts specified.

Another form of collaborative effort is joint problem solving (Johnston *et al.*, 2004; Pimentel Claro and Oliveira Claro, 2010). This form of collaboration is also called systematic collaboration. It involves joint activities in design work, mutual modifications of activities, adaptations of resources and repositioning in the actors'

dimensions (Johnston *et al.*, 2004; Gadde *et al.*, 2010). Finally, collaborative efforts include flexibility to make adjustments in unforeseen situations (Johnston *et al.*, 2004; Pimentel Claro and Oliveira Claro, 2010). This willingness may be due to new volumes or cost pressures when a supplier agrees to provide services beyond what has been agreed or when a buyer accepts substitute products or specifications (Johnston *et al.*, 2004).

From the literature, it is clear that the development of MIC among SMEs is critical as it may influence their relationship with larger customers. SMEs with strong MIC may appear well-resourced, managed or organised to their larger customers (Ngugi *et al.*, 2010). Indeed, an effective business strategy requires a positive synergy between exchange of resources with the environment and its ability to adapt to the environment so as to ensure an effective business strategy (Hakansson and Snehota, 2007). SMEs may develop MIC through strategic collaboration and planning with larger customers.

2.2.4 Cultural interaction capability

The final interaction capability is cultural. CIC is particularly important when firms are involved in the international market. In this market, business people may come from different backgrounds and cultures which require tolerance between parties. Culture is a unique concept that covers three main components – beliefs, values and customs – and often it is embedded in a society (Doodle and Lowe, 2012). Gilgeous (1995) refers to culture as beliefs, attitudes, norms and values that abide within an organisation, which may influence an employee's behaviour and emphasis in certain circumstances. Organisational culture can be defined as norms, beliefs and underlying values shared within a firm regarding appropriate business practices in the SC. In contrast, collaborative culture is concerned with a relationship orientation, with the aim of sustaining long-term relationships (Cao and Zhang, 2013).

CIC relates to the development of culture and values by both parties. The ability of SMEs to ascertain, understand and learn diverse cultures and values of larger customers would influence SMEs' actions in coping with any unexpected conflict and inconsistency in their relationships (Ngugi *et al.*, 2010). In addition, bilateral

development of culture and values can help SMEs to strengthen their position in a broader relationship (Johnsen and Tseng, 2010). Understanding cultural differences is significant in ensuring the success of a firm, as cultural factors can have the greatest impact on the interaction process between buyer and supplier. This is evidenced when language barriers have had impacts on the brand name of a firm. For example, General Motors was unsuccessful in Spain due to its product named “Nova” which means “no go” in Spanish. This has impacted on the General Motors brand name (Lewin and Johnston, 1997; Doodle and Lowe, 2012).

Development of culture and values seem to be influenced by the size of the firm and the maturity level of the relationships. It is evident that smaller firms and those in an early stage relationship tend to be influenced by larger customers’ culture and values. This is evident from the roles and specific behaviours that they adopt. In some cases, these SMEs are willing to change to ‘suit’ their larger customers. Learning and tolerating the values of larger customers appears to be important for early stage relationships as it creates opportunities for SMEs to find new potential customers within the same market (Johnsen and Ford, 2006; Talay and Dean, 2012). Bilateral development of suppliers’ and customers’ cultures and values may be a challenge to relationships at the mature stage because SMEs at this stage have developed their own culture through diverse relationships over the years (Talay and Dean, 2012).

Often, SMEs do not deal with one type of customer but various types that may come from regional or global countries. There are cases where component manufacturers or sub-suppliers are introduced to customers without any transition period which creates various problems for suppliers, such as the language barrier. As a result, conducting a cross-cultural learning and an international management would become key ingredients for firms to ensure they have long-term relationships (Johnsen and Ford, 2006) because individuals are key actors in the firms when conducting business interactions. They inherit and learn through numerous interactions (Ivanova-Gongne, 2015). Thus, it is important for firms to stimulate the cross-cultural learning across their staff.

Adapted from Johnsen and Ford (2006) framework, four components of interaction capabilities are identified, as presented in Table 2-3. In this study, “interaction

capabilities" is defined as the ability of an SME to interact effectively with larger customers.

Table 2-3: Definition of interaction capabilities and sub-components

Construct	Definition	Literature
Interaction capabilities	The ability of an SME to interact effectively with larger customers	Leonard-Barton (1992); Johnsen and Ford (2006); Johnsen and Tseng (2010); Cui and Hertz (2011); Talay and Dean (2012)
HIC	The ability of an SME to develop, combine and exchange knowledge, skills and expertise with larger customer	Leonard-Barton (1992); Grant (1996a); Ford (1997); Calantone *et al.* (2002) Johnsen and Ford (2006); Nonaka (2007); Cheung *et al.* (2010),
TIC	The ability of an SME to open up to technological innovation, combine existing technologies and collaborate on new technological configurations with larger customers	Leonard-Barton (1992); Hakansson and Lundgren (1995); Thomas and Ford (1995), Ford and Saren (1997); Bharadwaj (2000); Johnsen and Ford (2006); Ngugi *et al.* (2010); Cui and Hertz (2011)
MIC	The ability of an SME to plan and collaborate effectively with larger customers at a strategic level	Leonard-Barton (1992); Morris and Pitt (1993); Mohr and Spekman (1994); Samson and Terziovski (1999); Johnston *et al.* (2004); Johnsen and Ford (2006); Hakansson and Snehota (2007); Kim and Lee (2010); Pimentel Claro and Oliveira Claro (2010); Ngugi *et al.* (2010)
CIC	The ability of an SME to learn and be tolerant of larger customers' culture and values	Johnsen and Ford (2006); Johnsen and Tseng (2010); Ngugi *et al.* (2010); Talay and Dean (2012); Cao and Zhang (2013);

2.3 Participation

The SC is often made up of a network of buyers and suppliers, as depicted in Figure 2-3. The level of management in business relationships begins with an individual actor such as a person, business, firm or any type of organisation. The second level is the individual dyad such as buyer and supplier, which has been the focus in buyer-supplier relationships studies. This is where an individual or a firm simultaneously engage in several relationships that encompass an individual actor or firm's relationship portfolio and a number of tasks involved in managing the relationships. The level then expands to the next level, which is the portfolio, where it consists of the firm's indirect relationships with customer's customers or supplier's suppliers. Finally, a network level of management which arises due to interactions occurs among actors in the network (Ritter, Wilkinson and Johnston, 2004). This study was not interested in the growth of the SC as whole, rather in the relationships between two companies, specifically, the dyadic function of a

business relationship: a supplier who was smaller in size than its customers, as shown in Figure 2-3.

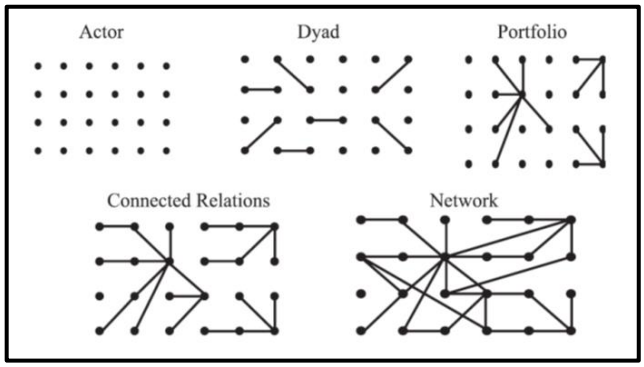


Figure 2-3: Levels of relationship and network management (adapted from Ritter *et al.*, 2004)

SMEs are in a series of dyadic relationships with their customers. Usually, their customers are larger than the SME. SMEs' growth is linked to their ability to sell more to their customers. A wide body of knowledge addresses SME growth. The topic has gained interest from researchers for two reasons: a) growth of an SME is an indicator of the firm's success and market acceptance, and b) high growth firms are responsible for most of the employment generation in developed countries. Despite the recognised importance of growth among SMEs, little attention has been given to the forms in which SMEs can grow. Barbero Navarro, Casillas and Barringer (2012) found that most of the growth literature tends to concentrate on growth factors and rates of growth.

In addition, there is increased attention towards encouraging SMEs to participate in global supply chains (GSCs) due to the opportunities they can offer (Yuhua, 2014; OECD and World Bank Group, 2015). There are also calls from the UK government to increase SMEs' participation in most competitive sectors due to a decrease in UK content, with only half of the UK demand for manufactured products supplied by UK manufacturers. It is reported that the automotive sector manufacturers source 60% of their parts from Germany and France compared to 40% from domestic suppliers (Department for Business Innovation & Skills, 2015). However, prior studies did not identify forms of participation. There is a paucity of studies that address how SMEs can measure their increase in participation.

Deane, McDougall and Gargeya (1991) have highlighted the importance of the interaction between manufacturing and marketing departments as a way to predict the success of new venture firms. Deane and his colleagues have made it clear that a stand-alone decision by either manufacturing or marketing is insufficient to gauge the success of a firm. Thus, in this study, three variables have been identified from a marketing perspective to explain the increase of participation among SMEs using Ansoff's matrix. As illustrated in Figure 2-4, the work by Igor Ansoff centres on growth strategies. The tool can be used by companies to decide which strategy should be taken in order to grow and what will be achieved with each strategy. Ansoff emphasised that, in order to remain competitive in the long-term, it is vital for firms to continue renewing themselves by bringing in new resources and developing new products and markets. This could be one of the indicators to measure potential long-term profitability through continued improvement of the external position. This is because accurate forecasting about return on investment (ROI) or other measures cannot be made in the long-run (Ansoff, 1968).

The tool is represented by two axes in which the vertical axis represents the growth strategies via markets and the horizontal axis denotes the growth strategies via products. The strategies can be divided into four: market penetration, market development, product development and diversification. In market penetration, firms usually focus on their current products and markets and this strategy can be seen as less risky. This strategy can lead to an increase in market share of firms. The second strategy is through product development where firms remain in their existing markets but focus on developing new products to replace the current ones. In the third strategy, market development focuses on current products but begins to explore opportunities in new markets. The last strategy is related to diversifying into related and unrelated businesses.

	Current products	New products
Current markets	**Market penetration strategies** Increase customer loyalty Increase market share Increase product usage (frequency of use, quantity used, new application)	**Product development strategies** Product improvement Product line extensions New products for same markets
New markets	**Market development strategies** Expand markets for existing products (geographic expansion, target new segments)	**Diversification strategies** Vertical integration (forward integration, backward integration) Diversification into related businesses (concentric diversification) Diversification into unrelated businesses (conglomerate diversification)

Figure 2-4: Ansoff matrix (adapted from Doyle, 2002)

This study, however, is less interested in which strategies SMEs should pursue to achieve high growth; rather, it is interested in the forms of measuring participation to enable SMEs to achieve benefits from customer relationships. Ansoff (1968) identified five categories of growth for improving external competitive position and two of them are related to products and markets. This is also supported by a study by Barbero Navarro *et al.* (2012), Ismail and Sharifi (2006) and Sharifi *et al.* (2013) in which they indicate that forms of growth can be achieved through product and market dimensions. This study, therefore, selects product and market as the forms to measure participation. Additionally, by combining product and market approaches, diversification is selected as another form to measure the participation.

As presented in Figure 2-5, an advanced version of Ansoff's matrix has been used as a guideline to explain the concept of participation. This version has removed some of the items which were irrelevant to participation. For example, increase customer loyalty under market penetration strategies was irrelevant to explain an increase of SMEs' participation in product, market or diversification dimensions. Another example is increase in market share. Each form of participation, product, market and diversification is discussed in the next sections.

	Current products	New products
Current markets	**Market penetration strategies** Increase product usage (frequency of use, quantity used, new application)	**Product development strategies** Product line extensions New products for the same markets
New markets	**Market development strategies** Expand markets for existing products (geographic expansion, target new segments)	**Diversification strategies** Vertical integration Diversification into related businesses Diversification into unrelated businesses (conglomerate diversification)

Figure 2-5: An advanced version of Ansoff's matrix

2.3.1 Product expansion

A product implies anything that is able to meet customers' functional needs. A product can be classified as a physical product, such as a watch, or a service product, such as a warehousing service. To align with the context of the study, it is the physical product that is studied. Product expansion can be measured in three ways: a) increase in product usage, b) extension of product line or range, and c) developing new products (Ansoff, 1957; Doyle, 2002).

An increase in product usage can be achieved through frequency of use, quantity used and new application. Frequency of use refers to the usage rate, such as how many times per day, week or month a shampoo is used. Therefore, it can be said that the frequency usage depends on the routine task requirements (Ram and Jung, 1994). The second type of product expansion is through extension of product line or range. In a manufacturing company, product line denotes the characteristics of both a) physical individual products, such as size or weight, and b) performance of the products (e.g. an aircraft's speed, range, or altitude) (Ansoff, 1988). Here, SMEs can increase their participation in conjunction with larger customers through new product lines and also additions to a product line. New product lines are usually new to the company, whereas additions to a product line are products that are new to the markets (Doodle and Lowe, 2012). SMEs can redesign the existing product through customisation and product families to be sold in a new market (Sharifi *et al.*, 2013). This type of participation, however, requires SMEs' flexibility

rather than cost as it requires modification of existing product functions or features (Ismail and Sharifi, 2006).

Subsequently, SMEs could also have the opportunity to grow their share with larger customers by meeting the new product and services' needs in both existing and new market segments. According to Strong (2014), new products may happen because of several situations, such as a technical breakthrough and emerging consumer needs. Innovation occurs after leading firms examine themselves and their environment to find out if any new problems need to be resolved or if there are any better ways to operate. Usually, innovation involves changes in either knowledge or habits (Strong, 2014). NPD includes launching of new products that are related or unrelated to product lines (Barbero Navarro *et al.*, 2012). SME NPD growth is also related to R&D and innovation (Wolff and Pett, 2006).

While firms are sometimes eager to develop new products, this form of participation poses a high level of risk. Based on the classic studies in the UK and the US, it is emphasised that for firms to succeed in NPD, marketing factors need to be focused on, as opposed to technical ones (Doodle and Lowe, 2012). This form of participation can be seen as an easier way for SMEs to increase participation as the manufacturing industry encourages more innovation through improvement in product performance or development of new products (IfM, 2016).

2.3.2 Market expansion

Another form of participation is market expansion. By growing share with larger customers, SMEs may have the opportunity to expand their operations by reaching different geographic markets or targeting new market segments (Ansoff, 1957; Doyle, 2002). Generally, researchers agree that firms can diversify their businesses in the same category of geographical areas (Shi and Gregory, 1998; Sturgeon, 2000). Shi and Gregory (1998) identified four geographical levels whilst Sturgeon (2000) grouped them into five levels in which Sturgeon differentiated between local and domestic. Geographical expansion is where firms in the SC structure can increase in scale from local, domestic, international, regional, and finally into global markets. Sturgeon indicated that local refers to firms that operate in the commute area. This type of supplier is also known as an industrial district

firm (Sturgeon, 2000). In this local context, firms operate as buyers or suppliers within a close proximity, where face to face interactions and rapid information flows are used to facilitate coordination mechanisms and innovation processes. As such, Chiarvesio and Di Maria (2009) have argued that exploitation in close proximity enables industrial district firms to compete and reach the next scale of geographical reach, i.e. the national and international level. Sturgeon (2000), however, uses the term “domestic” instead of “national”, referring to firms that serve a single country as domestic. Shi and Gregory (1998) used the same term, i.e. “domestic”, but mentioned clearly that it serves both home and export markets. The scale continues to increase in international, regional and global markets. International covers more than one country (Sturgeon, 2000); Shi and Gregory (1998) referred to it as “multinational” where it involves plants located in several economic sectors or countries. “Regional” confines the operations to multi-country trade blocs such as the EU, the Association of Southeast Asian Nations (ASEAN) or North America, as within these regions are shared similar culture systems (Shi and Gregory, 1998; Sturgeon, 2000). The last scale is the global scale which denotes the geographic reach but does not require volume of activity or total geographic coverage in every country, region or every continent (Sturgeon, 2000).

Through market dimension, SMEs can increase their participation in larger customers’ SCs through new types of customers. SMEs can attract new larger customers for their existing products in other new channels of distribution or new geographical areas (Hulbert, Gilmore and Carson, 2013). In this study, geographical markets are divided into four. The first is the local region, which refers to the closest county that the SMEs operate in, such as West Midlands and North East England. This is followed by the country itself, in this case the UK, which Sturgeon defines as domestic. The geographical scale can expand to Europe, which is regional, and to the rest of the world, which can also be termed as global. The successful firms may able to increase their operations from serving a limited market to that of a broader market (Deane *et al.*, 1991).

In the SC, SMEs may not be operating in one market with homogeneous customer needs; instead, their larger customers demand different benefits, such as quantity, quality and prices to pay. Thus, SMEs can increase their participation by segmenting the market through specialisation and tailored offerings. SMEs may

grow their business with larger customers by repositioning their products within different market segments (Hulbert *et al.*, 2013). Market segmentation can be defined as *"a customer group within the market that has special characteristics that are significant for a marketing strategy"* (Doyle, 2002, p.62). Frynas and Mellahi (2015) have pointed out that market segmentation helps firms to better understand their customers. Segmentation can be seen as one innovative way for SMEs to achieve competitive advantage. It can stimulate demand in various ways and this is evident through the example of IKEA where its success lies in its ability to identify new market segments. IKEA, which started as a small company, has managed to become a global company with a wide portfolio through smart market segmentation. The company started by introducing inexpensive furniture, to be assembled by customers at their locations, to the market in designer furniture (Bowonder *et al.*, 2010).

2.3.3 Diversification

Firms' strategies are not static; instead they evolve to align with the changes in the market. As such, firms need not only to expand but also to diversify their business. Diversification is usually applicable in international markets when there is a significant loss in the demand for the firm's existing products. Diversification is the highest risk option for SMEs to increase their participation as it involves the simultaneous movement of current products and markets. In diversification, the common thread is unclear and to some extent weaker when compared to product-market scope expansions (Ansoff, 1988). This is because SMEs that pursue diversification need to learn the new skills, knowledge, techniques and facilities of new markets and products (Doyle, 2002; Ansoff, 1957). However, there are several underlying reasons that explain the rationale behind diversification. Several studies have explored a number of reasons for diversification and these have been summarised by Ansoff (1968) into four main points:

a) Firms are no longer able to meet the objectives of product-market scope expansion

b) The retained cash of the firms exceeds the total expansion needs

c) Diversification opportunities provide greater profitability than expansion opportunities, and

d) Firms lack the information needed to make a conclusive comparison between expansion and diversification.

Increase in diversification can go into different dimensions, where every dimension has its own characteristics and risks. In general, SMEs can increase their participation through vertical integration, concentric diversification or conglomerate diversification. Vertical integration implies ownership of a firm on vertically-related activities (Grant, 2015). Frynas and Mellahi (2015) have defined it as when a firm expands its activities into suppliers' or customers' activities. In this integration, SMEs branch out their parts, components and materials of production (Ansoff, 1957). For instance, Zara is a Spanish clothing retailer that applies vertical integration in its manufacturing. Through a vertical SC, Zara was able to move from clothes design to production and to sales within three weeks, something that led Zara to shorten its lead times (Frynas and Mellahi, 2015). However, this form of participation is more sensitive to volatilities and it offers less flexibility (Ansoff, 1968).

Another way of growing share with the larger customers is concentric diversification (Doyle, 2002). This is where firms diversify into related business. Here SMEs look for opportunities to create new products, or new markets that lie within their current products, markets and knowledge (Ansoff, 1957; Doyle, 2002). Take the example of Johnson and Johnson which, starting from making products such as sterile sutures and dressings for human health and well-being, later expanded into products related to babies, first aid, women's sanitary items and personal care (Frynas and Mellahi, 2015). In this form of participation, SMEs are less flexible and make less contribution towards the improvement of the businesses as the firms continue to sell using existing marketing channels (Ansoff, 1968).

Another strategy in which SMEs can grow is through conglomerate diversification. SMEs that pursue this strategy tend to diversify into business unrelated to that which they are currently in; the new products or markets are not related to current business in terms of products, technology or markets. For example, Giorgio Armani has diversified from haute couture into everyday clothes, accessories, watches, cosmetics, as well as furniture such as Casa Armani, nightclubs in Milan, and

flowers with Armani Fiori. These businesses present the way Giorgio Armani has shared its technological knowledge and business processes (Frynas and Mellahi, 2015). At first glance, concentric diversification seems to be preferred but in reality most firms follow the path of conglomeration for a number of reasons: firstly, when firms have no other strategy than to pursue for profitable opportunities; secondly, when firms' capabilities are too specialised, for instance in the manufacturing industry, or too obsolete to have collaboration with other types of business; thirdly, when the depth of competence for some firms is too narrow to have synergy with other types of business, thus, all diversification shifts towards conglomerates; and finally, the structure of the firms, which leads to conglomerate diversification (Ansoff, 1968). In addition, Ansoff added that conglomerate diversification offers several benefits including improvement in the overall profitability and flexibility of the firms, better access to capital markets, and better stability of earnings.

Table 2-4: Definition of SME participation and summary of the literature

Construct	Definition	Literature
Participation	The extent of SMEs' participation in larger customers' SCs	Ansoff (1957, 1968, 1988); Deane *et al.* (1991); Ram and Jung (1994); Shi and Gregory (1998); Sturgeon (2000); Doyle (2002); Ismail and Sharifi (2006); Barbero Navarro *et al.* (2012); Doodle and Lowe (2012); Hulbert *et al.* (2013); Sharifi *et al.* (2013); Strong (2014); Frynas and Mellahi (2015)

In summary, drawing from the above literature, SME participation can be defined as the extent of SMEs' participation in larger customers' SCs. It can be measured in three dimensions. First, product expansion in which SMEs gain more product usage from existing larger customers and seek to attract new larger customers. Here, SMEs can expand their products by introducing entirely new products. Second, SMEs expand their market by attracting new larger customers from new channels of distribution, new market segments as well as new geographical areas. Third, SMEs diversify their businesses where new products are developed for new markets. Table 2-4 provides the definition of SME participation and summarises the relevant literature.

2.4 Firm performance

As SMEs increase their participation in larger customers' SCs in terms of product, market and diversification, the firm performance of the firms also increases. In any businesses, performance can be measured through either "hard" or "objective" measures such as sales, growth and profits, or "soft" measures such as performance appraisals (Ambler and Kokkinaki, 1997). A set of objectives may either be implicit or explicit: implicit can be in the form of past history or individual motivations, whereas explicit covers the key strategic plans of the companies (Ansoff, 1968). One of the key strategic plans includes firm performance. Historically, an organisation's motivation to succeed has primarily been associated with financial objectives such as growth and profit; however, over time, firms have sought other non-financial objectives such as customer service, product quality and improving quality of life (Ansoff, 2007).

The word "performance" is widely used and its definition varies according to the context. Performance can be defined as today's action that leads to tomorrow's measured outcome (Lebas and Euske, 2002). Research indicates that there is a high interest in performance measurement systems (PMSs) resulting in the development of different frameworks, such as the Balanced Scorecard (BSC), performance measurement matrix, results and determinants framework, and integrated performance systems to enable organisations to assess their performance (Biazzo and Garengo, 2012).

In this context, financial performance was the focus as it can serve three main functions. Firstly, financial performance measures can serve as a tool for managing finance; the tool guides the owners of the SME firm or specific finance division to use the resources wisely to meet the vision of the organisation, which can lead to effective and efficient operation of the division. Secondly, financial performance measures such as ROI and market share can be used to gauge the performance of the firm since financial performance is a key objective of any organisation. Thirdly, financial performance measures can be mechanisms to motivate and control the operation of the firms.

There are a number of indicators to measure business performance, which can be summarised into financial results, such as return on sales (ROS) and return on assets (ROA), productivity measures such as cost reductive indexes, and growth measures such as revenue per market share segment/product category (Biazzo and Garengo, 2012). This is aligned with the framework of the BSC by Kaplan and Norton (1996). The framework provides a more balanced approach by emphasising four different perspectives with two of them covering financial aspects, such as sales growth and return on capital employed (ROCE), and customer aspects, such as market share and profitability, in which the term "customer" is adopted in Kaplan and Norton's work as opposed to "growth". The other two aspects focus on business processes and human resources. SME characteristics are heterogeneous in nature and their emphases are different from each other. Thus, in order to sustain SMEs' performance, growth measures of market share, market share growth, ROS and ROS growth, and financial measures of ROI and ROI growth were adopted in this study.

Market share, ROS and growth of the two dimensions were selected because they are widely used in both OM and marketing to measure firm success and to assess the performance of small firms (McDougall *et al.*, 1994). These measures are usually applicable at the early stage of their life cycle, considering the rapid growth level. At this stage, firms focus on development and enhancement of products and services, and investment in systems and infrastructure (Kaplan and Norton, 1996). In OM, these dimensions are used to assess market performance (Droge, Vickery and Markland, 1994; Kaynak, 2003). In marketing, market share and profitability are the most common indicators of performance (Ambler and Kokkinaki, 2002). However, different findings were revealed in other studies measuring success. Sales and sales growth were found to be the key indicators of success (47%), followed by market share (36%) and other traditional measures. Moreover, measures such as market share growth have been identified as key measures in performance improvement measurement system (PIMS) studies (Droge *et al.*, 1994). In terms of financial aspects, ROI and ROI growth were used as they aim to improve returns and broaden revenue mix. ROI is a conventional method of addressing business performance. The choice of firm performance measures was consistent with the framework: "typical measures concern profit in relation to sales

and investment as well as growth in relation to market-share growth" (Curkovic, Vickery and Droge, 2000; da Silveira, 2005).

Table 2-5: Definition of firm performance and summary of the literature

Construct	Definition	Literature
Firm performance	Evaluating the SMEs' performance against that of major competitors	Droge *et al.* (1994); McDougall *et al.* (1994); Kaplan and Norton (1996); Biazzo and Garengo (2012)

In summary, in this study, the financial business performance of ROI, ROI growth, market share, market share growth, ROS and ROS growth were selected. Table 2-5 shows the definition and key literature of firm performance.

2.5 Summary

This chapter has identified and discussed components of a conceptual framework. The conceptual framework (Figure 4-2) based on Johnsen and Ford's (2006) work, is explained in Chapter 4. Their original framework identified four interaction capabilities, and this study further extended it by adding components of "participation" and "firm performance".

3 RESEARCH DESIGN

3.1 Introduction

This chapter presents an overview of the methodology that was adopted in this research. The chapter begins by discussing different research paradigms in Section 3.2. It reflects different beliefs about knowledge, which may influence the design of the study. Section 3.2.1 provides an overview of the adopted philosophical foundation and how it shaped the approach to the research. Reflecting the adopted philosophical assumption, Section 3.3 presents the research design used in this study. Prior to that, it also reviews different methodological approaches that are relevant in the area of operations supply chain management (OSCM). To help answer the overarching research question, three phases of research design are involved. The first phase begins with a scale development of interaction capabilities. A step-by-step approach to scale development is explained in Section 3.4, followed by empirical work in the second phase (Section 3.5) and case studies in the third phase (Section 3.6). Specifically, Sections 3.5 and 3.6 describe the data collection procedures, analysis and interpretation that are involved in each area of fieldwork. Finally, the chapter turns to ethical issues, discussing considerations that need to be anticipated in each phase of the research design (Section 3.7) and the chapter concludes in Section 3.8 with a summary. Figure 3-1 illustrates the structure of the chapter.

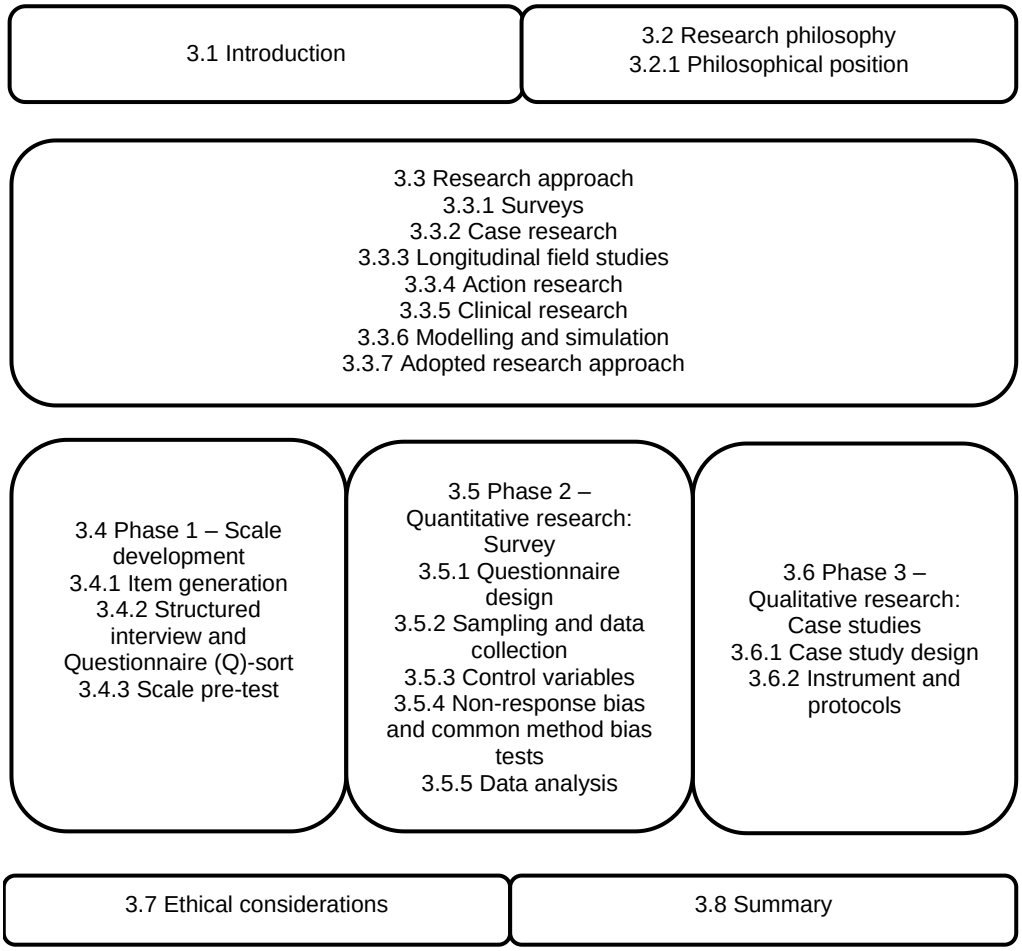


Figure 3-1: Structure of Chapter 3

3.2 Research philosophy

As a management researcher, it is critical to have a deeper understanding of philosophy, as failure to do so might impact on the quality of the research. There are reasons behind the importance of having a thorough knowledge of philosophy (Easterby-Smith, Thorpe and Lowe, 2002). Firstly, it provides clarification on the research design. Secondly, it assists the researcher in deciding which designs to pursue. Thirdly, it helps the researcher to identify or create designs that may be beyond his or her experience.

In philosophical enquiry, the facts, theory, alternatives and ideas are brought together and weighed against each other in the creation of knowledge (Chia, 2002, p.2). Philosophical debates have revolved around ontology, epistemology,

methodology and methods. A short description of each term is provided below (Easterby-Smith *et al.*, 2002):

a) **Ontology**: assumptions that we make about the nature of reality.
b) **Epistemology**: a general set of assumptions about the best ways of enquiring into the nature of the world.
c) **Methodology**: combination of techniques used to enquire into a specific situation.
d) **Methods**: individual techniques for data collection and analysis.

Ontology can also be viewed as philosophy or metaphysics, in that it implies how people position themselves in describing the world. It usually deals with the question “What is the nature of reality?” After adopting an ontological stance, it directs researchers to epistemology which can also be regarded as methodology. It assists researchers in exploring the world by conducting qualitative or quantitative or mixed methods. The connection of these two helps researchers to decide what methods or tools should be used in the exploration. This can be achieved through various tools, such as case study, questionnaires, content analysis, narrative analysis and conversation analysis.

Although there is an ongoing debate about what world views are fit to the scholars, this research will review postpositivism, constructivism and pragmatism which are among the philosophical foundations that are widely discussed in the literature. Traditionally, postpositivism is represented as a traditional form of research; it is also known as positivist or postpositivist research, and empirical science and postpositivism. The latter is called postpositivism because the thinking emerged after positivism, realising that the world cannot be completely positive about the claims of knowledge when researching humans behaviour and actions (Creswell and Creswell, 2018).

Postpositivism adopts a quantitative approach which tends to be objective and focus more on facts, evidence, logics, and reports. In contrast, constructivism is more likely to be subjective and seeks to interpret meanings, experience and feelings (Lee, 1991; Easterby-Smith *et al.*, 2002). As such, constructivism or social constructivism, which is often combined with interpretivism, is more associated with a qualitative approach (Creswell and Creswell, 2018).

Postpositivists hold a view that the social world exists externally and its properties can be measured through objective methods such as experiments, mathematical analysis, and hypothesis testing. On the other hand, social constructionism has emerged from the view that the social world is not objective; instead, it is subjective and socially constructed by people. The principle of social constructionism implies that people make assumptions of the world through sharing of experiences or the medium of language (Lee, 1991; Easterby-Smith *et al.*, 2002).

In addition to these two philosophical paradigms, another group of individuals believes in the philosophical assumptions of pragmatism. Scholars in this paradigm are concerned with the consequence of the research, with the use of multi-methods of data collection to inform the research problem and with the research question rather than the research method. Thus, pragmatists can be typically associated with mixed methods and adopt whatever philosophical and/or methods approach that works best for the particular research problem (Tashakkori and Teddlie, 1998; Creswell and Clark, 2018).

After comparing all the world views, in the next section, the philosophical stance of the research is discussed.

3.2.1 Philosophical position

Due to the nature of the research undertaken for this thesis, this study is conducted from the viewpoint of pragmatism. Within this paradigm, pragmatist researchers assume both singular and multiple forms of reality. In contrast, postpositivism views the reality as singular, whereas constructivism views the reality in multiple perspectives (Creswell and Clark, 2018). As such, postpositivism tends to either reject or accept hypotheses, whereas constructivism uses quotes to illustrate multiple viewpoints. Unlike postpositivism and constructivism, pragmatism allows this research to test hypotheses and provide manifold perspectives to explain the role of interaction capabilities in increasing SMEs' participation in an HVM SC context.

While postpositivists hold an objective point of view and constructivists adopt a subjective point of view, pragmatists adopt both points of view in their

epistemological orientation. Here, the researcher is neither one nor the other as the pragmatists' contention is that scientific inquiry is not 'formalistic' (Tashakkori and Teddlie, 1998). Pragmatist researchers confute the claim made by postpositivists about the "truth" and constructivists about the "reality"; instead, pragmatists collect data based on "what works" at the time to address the problem under study (Teddlie and Tashakkori, 2009).

As pragmatism holds to "what works", it rejects the either-or choices (uses either QUAL methods or QUAN methods) presented by the incompatibility thesis (Teddlie and Tashakkori, 2009). It allows the use of both qualitative and quantitative methods in a single study. Pragmatists have a choice of using inductive and deductive logic in conducting the research. They have the flexibility to combine both deductive logic, which is typically adopted by postpositivists who work from a theory to hypotheses to draw conclusions, and inductive logic, which is the approach of a constructivist. Inductive logic works from the bottom up, in which participants' views are used to build themes and generate a theory linking those themes. Combining both enables this research to begin with a broad survey in order to generalise the results to the HVM context; then, in the second stage, case studies are used to collect detailed information from the participants to help in validating the survey results. The integration of both methods allows additional insight into the research problem beyond what each qualitative or quantitative method could provide.

In the next section, a type of methodology that aligns to the adopted philosophy is explored.

3.3 Research approach

In OM, there are many research approaches that can be employed by researchers (Flynn *et al.*, 1990; Ahlstrom, 2016). They can be categorised into qualitative, quantitative and mixed methods (Creswell, 2009). Creswell has called them strategies of inquiry, where they navigate researchers to procedures in a research methodology. Quantitative strategies may include experimental designs and non-experimental designs such as surveys. On the other hand, qualitative research encompasses case studies, ethnography and longitudinal field studies. Mixed

methods, however, employ multimethod approaches in data collection; for example, interviews (qualitative data) combined with surveys (quantitative data).

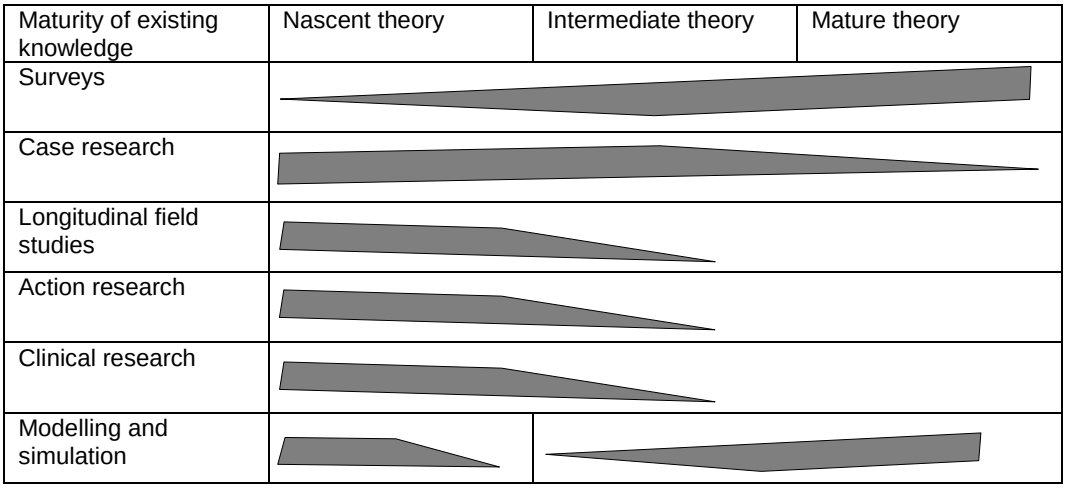


Figure 3-2: The relationship between existing knowledge and research approach (adapted from Ahlstrom, 2016)

According to Ahlstrom (2016), each approach can be applied depending on the maturity of the knowledge, as shown in Figure 3-2. For instance, surveys are preferred when existing knowledge is mature, as they are used in the theory-testing stage. In contrast, case research tends to be used in theory-building but can also be used in theory-testing and theory-refining. In the next sections, all these research approaches are discussed.

3.3.1 Surveys

A survey research studies a sample of a population through a quantitative or statistical description of trends, attitudes, or opinions of the population (Malhotra and Grover, 1998; Creswell, 2009); results of the sample can then be generalised to the whole population. Researchers who employ surveys tend to adopt positivist/postpositivist or postpositivism as their philosophical assumption. These researchers are typically interested in numerical data (Teddlie and Tashakkori, 2009).

Survey research can be used for different purposes. Often, researchers employ survey research to explore, confirm and give a description of a phenomenon (Flynn *et al.*, 1990; Filippini, 1997; Forza, 2002). In exploratory survey research,

researchers aim to gain a fundamental insight or become familiar with a particular topic, and this offers a foundation for them to conduct a more in-depth survey. Usually, this type of survey is conducted at the early stages of research and no model is involved. However, it requires OM researchers to fully understand and measure the concepts of interest. Another type of exploratory research is called "descriptive" survey research (Malhotra and Grover, 1998; Forza, 2016). The objective of this type of survey is to provide a description of events or opinions and their distribution. Traditionally, descriptive survey research has been used in most OM surveys (Filippini, 1997). For example, Filippini in his research described the evolution of research approaches, models and empirical studies in OM.

Explanatory research has been argued to be the most important type of survey research (Malhotra and Grover, 1998). Known as theory testing or verification, this type of survey is usually employed when understanding of a phenomenon has been articulated in a theoretical form using conceptual models, propositions and concepts (Forza, 2002). This research is aimed at testing the hypotheses generated through data collection and finding the causal relationships among variables. It answers why and how the variables should be connected (Flynn *et al.*, 1990; Malhotra and Grover, 1998). Hypothesis generating and testing can be achieved through deduction and induction processes. These approaches can be combined and applied in the same research. Hypotheses could be in the form of basics, such as a relationship exists between 'X' and 'Y', or directional, such as positive or negative (Malhotra and Grover, 1998; Forza, 2016).

In survey research, data can be collected in a variety of ways and from different sources. However, the main methods of data collection are interviews and questionnaires (Forza, 2002). Interviews may be structured or unstructured and can be conducted face-to-face or over the telephone. In contrast, questionnaires can be self-administered, by telephone or through the web and can also be posted or emailed to the respondents (Filippini, 1997; Forza, 2002). Each method has merits as well as drawbacks. Table 3-1 shows a comparison of the different methods of survey data collection. In Table 3-1, "1" denotes the highest strength of the method and "4" indicates the lowest strength. Choosing the best method depends on the specific needs of the survey, and time, cost and resource constraints.

Table 3-1: Comparisons of data collection methods (adapted from Miller, 1991; Forza, 2016)

Factors influencing coverage and secured information	Mailed	Face-to-face survey	Telephone survey	E-survey
Lowest relative cost	2	4	3	1
Highest response rate	4	1	2	3
Higher accuracy of information	2	1	4	3
Largest sample coverage	1	4	3	2
Completeness, including sensitive materials	3	1	2	4
Overall reliability and validity	2	1	3	4
Time required to secure information	4	2	1	3
Ease of securing information	1	4	3	2

Traditionally, self-administered surveys were distributed by post where questionnaires were printed and mailed to the respondents (Klassen and Jacobs, 2001; Forza, 2016). Postal surveys are very effective for well-defined areas (Flynn *et al.*, 1990). Since the beginning of the 1990s, there has been a change in the way questionnaires are distributed; questionnaire distribution has become easier via fax and email. With the use of the Internet and World Wide Web, scholars could administer the survey in two different ways: attaching the instrument to the email message or inserting a Web link in the email for an online survey questionnaire (Klassen and Jacobs, 2001). In a face-to-face survey, the interviewer gathers data directly from a respondent during the interview. The telephone survey, on the other hand, involves data collection that is conducted by a phone interview between a respondent and an interviewer (Forza, 2016).

Referring to Table 3-1, the face-to-face survey has more merit compared to other methods. This method tends to receive the highest response rates, followed by the telephone survey method. This may be due to the ability of respondents to clarify complex questions to the interviewer. A very limited amount of reading required by respondents also increases the likelihood for them to complete the questionnaire. In face-to-face and phone surveys, more aural and verbal skills will be utilised by the respondents (Dillman, 1991). The ability to clarify questions with the interviewer will also improve the accuracy of information provided by the respondents and increase the overall reliability and validity of face-to-face surveys. In addition, the

presence of the interviewer will ensure the completeness of the survey questionnaire.

Aside from these advantages, the face-to-face survey is the most expensive method. For this reason, some studies have opted to use an electronic survey, which is the cheapest among all the survey methods. Nonetheless, the electronic survey appears to have lower response rates relative to face-to-face and telephone interviews (Miller, 1991; Forza, 2016). The web-based survey has been found to have a lowest response rate compared to other technologies such as mail, fax and personal computer disk-by-mail. Lower response rates are tolerable if the sample coverage is larger (Klassen and Jacobs, 2001). Electronic surveys can also guarantee the security of the collected information.

3.3.2 Case research

In OM, case research has consistently been one of the most dominant research methods, specifically in developing a new theory (Voss, Tsikriktsis and Frohlich, 2002). The case study is usually positioned under a research paradigm of social constructivism or constructivism, employing both qualitative and quantitative tools and methods to understand a particular phenomenon (Meredith, 1998). The central idea is to understand the dynamics occurring within the single settings by exploring a specific phenomenon in-depth and in a limited scope of study (Eisenhardt, 1989; Meredith *et al.*, 1989). In collecting the data, Yin (2018) has identified several sources of evidence that can be used in case research as listed below:

i. Documentation consists of written materials such as emails, agendas, administrative documents and newspaper clippings
ii. Archival reports include organisational, government and service records
iii. The interview is the main source of case study data collection. This includes structured interviews, unstructured interviews and survey interviews (Benbasat, Goldstein and Mead, 1987; Voss, Johnson and Godsell, 2016; Yin, 2018)
iv. Direct observations range from formal to personal data collection
v. Participant observation
vi. Physical or cultural artefacts – for example, devices, tools, instruments

Similarly to the survey research, case research can be used in different stages of knowledge maturity, as illustrated in Figure 3-2. Specifically, case research can be conducted in three modes (Ketokivi and Choi, 2014). First is theory generation, which is useful when theory is not yet available. Here, researchers conduct empirical research to look for interesting and insightful patterns (Stuart *et al.*, 2002). In theory generation, the research objectives of *what, how* and *why* can be applied (Meredith, 1998). The second type of case research is theory testing. This case research applies a deductive approach where a general theory is used as a basis to examine if relationships between activities and events exist (Stuart *et al.*, 2002; Ketokivi and Choi, 2014). For this type of research, the case study may be employed in conjunction with survey research to achieve triangulation (Voss *et al.*, 2002). The third type is theory elaboration, which follows a similar logic to theory testing. The main difference is that researchers do not seek to test the underlying logic but to elaborate and modify, refine and extend it (Ketokivi and Choi, 2014; Voss *et al.*, 2016).

A case study can consist of either single- or multiple-cases. Deciding whether to conduct a single-case or multiple-cases is an important element that researchers need to decide prior to any data collection (Yin, 2018). The single-case study is mostly fitted for totally new or exploratory investigations (Meredith, 1998). In the single-case study, detailed information is gathered at one site. It may be used along with some other methods such as surveys to provide explanations for the findings. In contrast to the single-case study, a multiple-case design is suitable when there is some available knowledge about the phenomenon but much is still unknown (Meredith, 1998). The multiple-case study is suitable for descriptive, theory building or theory testing (Benbasat *et al.*, 1987). Unlike the single-case study, multiple-case studies collect information at each of several sites, although the same information might not be collected from each (Flynn *et al.*, 1990). This leads to within- and cross-case analysis (Benbasat *et al.*, 1987; Barratt, Choi and Li, 2011).

Case research offers three main strengths. First, it allows researchers to study the phenomenon in a natural setting and generate theory from practice (Benbasat *et al.*, 1987). This ensures the case study results have a very high impact (Voss *et al.*, 2016). Second, case research design answers important research questions, i.e. *why* and *how,* through an understanding of the nature and complexity of the

phenomenon. Third, it is a good vehicle to study an obscure area where only a few studies have been carried out (Benbasat *et al.*, 1987). Despite these strengths, there are several challenges faced by researchers when conducting case research. As researchers need to be present, their time, costs and skills will be demanded. It also requires researchers to be familiar with the case study procedures and rigour. In case research, there is also a need for multiple means of data collection and tools for triangulation. The triangulation, however, will further increase the validity (Benbasat *et al.*, 1987; Voss *et al.*, 2002).

3.3.3 Longitudinal field studies

A longitudinal study is a case study research as it aims to study a phenomenon or people in a natural setting. The longitudinal study has a number of features that distinguish it from case research. It also differs from a cross-sectional study. In cross-sectional studies, data are collected within a specific time period, such as days, weeks or months, to study a historical phenomenon (Malhotra and Grover, 1998; Sekaran, 2003; Ahlstrom and Karlsson, 2016). For instance, data were gathered from businesses in October 2017 to study how industries are preparing for Brexit. On the other hand, longitudinal research studies a phenomenon that changes over a period of time (Malhotra and Grover, 1998; Sekaran, 2003; Ahlstrom and Karlsson, 2016). The longitudinal study can also be seen as a number of cross-sectional studies conducted not just for one point in time (Ahlstrom and Karlsson, 2016). For instance, a research is conducted over time to study how manufacturing companies become competitive after implementing just-in-time (JIT). Researchers, then, visit the companies quarterly to see the improvements over a two-year time horizon.

Within OM, there is very little literature covering longitudinal studies (Ahlstrom and Karlsson, 2016); according to them, this type of research design is applicable for theory generation but not for testing theory. Conversely, Filippini (1997) highlighted that longitudinal studies are more suitable for seeking a relationship or causal inferences between variables. For this type of confirmatory study, hypotheses need be clearly generated as well as for sampling procedures and data collection; they need to be well-defined. Similarly, Malhotra and Grover (1998) state that longitudinal study design can provide greater confidence in terms of causality but

it is difficult to implement. First, it demands time and effort from the researchers; they need to make an effort to engage with the organisation. Second, researching on one organisation can lead to shortcomings such as generalisation, as the chosen organisation might not be a suitable representative for the phenomenon being studied. Third, gaining access to organisations is, arguably, the major obstacle of longitudinal studies. Often, organisations tend to keep their conflicts internally (Ahlstrom and Karlsson, 2016).

3.3.4 Action research

Becoming a prominent research among management researchers, action research covers action taking and knowledge or theory generation about the action taken (Eden and Huxham, 1996; Coughlan and Coghlan, 2002). In Coughlan and Coghlan's (2002) studies, they have identified some characteristics of action research. First, researchers take action instead of observing what is happening. In OM, action researchers are actively involved in making the action happen in areas such as process and product improvements, supplier change and materials substitution. The approach of the action researcher is collaborating with those directly involved in social or organisational issues to explore the resolution of the issues. Second, action research is collaborative, in which members in the project work actively through four cyclical processes: planning, taking action, action evaluation and further planning. Third, research and action are conducted simultaneously as action research has two goals: solving a problem and contributing to practice. Finally, action research consists of both a sequence of events and a problem solving approach. In the sequence of events, four main steps of constructing, planning action, taking action and evaluating action are involved (Coughlan and Coghlan, 2016).

As illustrated in Figure 3-2, action research is mostly useful for theory building. Here, a researcher works together with managers to have a deeper understanding of the phenomenon (Westbrook, 1995; Ahlstrom, 2016). The researcher attempts to guide the situation in a positive way while undertaking data collection and observation of dependent variables (Meredith *et al.*, 1989). Furthermore, Eden and Huxham (1996) have highlighted that action research must have some implications beyond the theory generation of the project. This means that the results must, in

general, not be specific, which could inform other contexts at least in the form of suggestions or considerations. As the researcher is part of the project, hypothesis testing is less appreciated (Westbrook, 1995). Similarly, Eden and Huxham (1996) raised the point that action research is not a good research design for theory testing due to the nature of action research. A repeatable experiment does not fit into the nature of action research, as each intervention will be different from the previous one.

3.3.5 Clinical research

Clinical management research was first formulated by Edgar Schein through a concept of process consultation. He argued that the concept begins with the needs of a client (Schein, 1995). The client approaches a researcher and the research begins when the researcher starts to inquire and drive the helping process (Karlsson, 2016). Part of the helping skill of the researcher is to know how to interchange between various kinds of interventions (Schein, 1995). There are two key features of clinical research. First, the researcher is asked to intervene to help the organisation and second, concurrently conduct the research about the organisation. Some of clinical management research features include:

i. Providing deep and rich insights as it involves both a concurrent problem solving and research development
ii. Interesting theory and practice through intervention of the researcher in implementing new tools and the changes it may involve
iii. Concurrent collaborative knowledge development
iv. The researcher acting as a clinician as he/she becomes involved in the organisation's issues

In conducting clinical management research, six roles are involved which can be broken down into researchers and organisations. The former are senior researcher and research assistant while the latter are the client, sponsor, liaison officer and steering group. Management clinical research can be carried out through case, longitudinal and action research. The research is concerned with the causal relations and causal questions of why approaches are used. The key strength of clinical management research is the mutual benefits of intervention. The client will

reveal all the confidential data as the client is the one who has asked for problem solving. Unfortunately, this strength is offset by the drawback that the client may not allow any publications (Karlsson, 2016).

3.3.6 Modelling and simulation

Modelling and simulation is one of the traditional methodologies in operations (Meredith *et al.*, 1989). It is useful for theory verification where causal relationships can be made explicit (Flynn *et al.*, 1990; Bertrand and Fransoo, 2016). Quantitative modelling (labelled operational research (OR)) has been the foundation of initial research on operations in Europe, while in the US, it was the basis for initial management consultation (Bertrand and Fransoo, 2016). Parallel to this, Sekaran (2003) and Shafer and Smunt (2004) stated that simulation has been widely employed in business and in computer simulation for OM research. This was evidenced in Shafer and Smunt's (2004) research in which approximately 600 published simulation articles were identified in OM from 1970 to 2000.

Quantitative modelling can be classified into rational/existential dimensions, based on the assumption that objective models can be built to explain the behaviour of real-life operational processes or capture the decision making problems that are faced by executives in real life (Meredith *et al.*, 1989; Bertrand and Fransoo, 2016). It can be broken down into axiomatic and empirical quantitative modelling research. Axiomatic quantitative modelling aims to obtain solutions within the defined model and ensure the solutions provide important insights into the problems prescribed in the model (Bertrand and Fransoo, 2016). Axiomatic examples are normative modelling and descriptive modelling (Meredith *et al.*, 1989). Empirical quantitative modelling can be both descriptive and prescriptive. Descriptive empirical modelling is concerned with creating a model that describes how causal relationships exist in the real world, while prescriptive empirical research is primarily concerned with developing policies, strategies and actions to improve the current states (Bertrand and Fransoo, 2016).

Of the two approaches, mathematical simulation is more common in operations. It includes both artificially created and elements of reality. It can be either stochastic such as “Monte Carlo” or deterministic such as “industrial dynamics” (Meredith *et*

al., 1989; Sekaran, 2003). Simulation is an alternative to laboratory and field experiments, which employs a model-based quantitative technique to determine the effects of changes (Sekaran, 2003). On the other hand, Choi, Cheng and Zhao (2016) claimed that analytical modelling is possibly the most important methodology in OM research. The methodology employs methods such as optimisation model analyses, closed-form economics model analyses, simulation studies and computational experiments. These methods can be found in economic analysis and optimisation studies. They are published in OR, OM and management sciences journals.

3.3.7 Adopted research approach

The preceding discussions showed that all research methods serve different purposes of the research and none of the research approaches is perfect. In this thesis, mixed methods are adopted. Mixed methods research is defined as the type of research in which a researcher or a team of researchers collect, analyse and integrate both qualitative and quantitative data rigorously for an in-depth understanding (Johnson, Onwuegbuzie and Turner, 2007; Creswell and Clark, 2018).

In this research, mixed methods are used to serve the purpose of confirming the results of the first study. Aligning with Tashakkori and Teddlie (1998), mixed methods can be applied to explain or validate the results of the main study. This design is also called interpretation, in which an additional study is adopted to interpret and prove findings obtained in the main study. Here, data are collected sequentially but interpreted concurrently (Golicic and Davis, 2012).

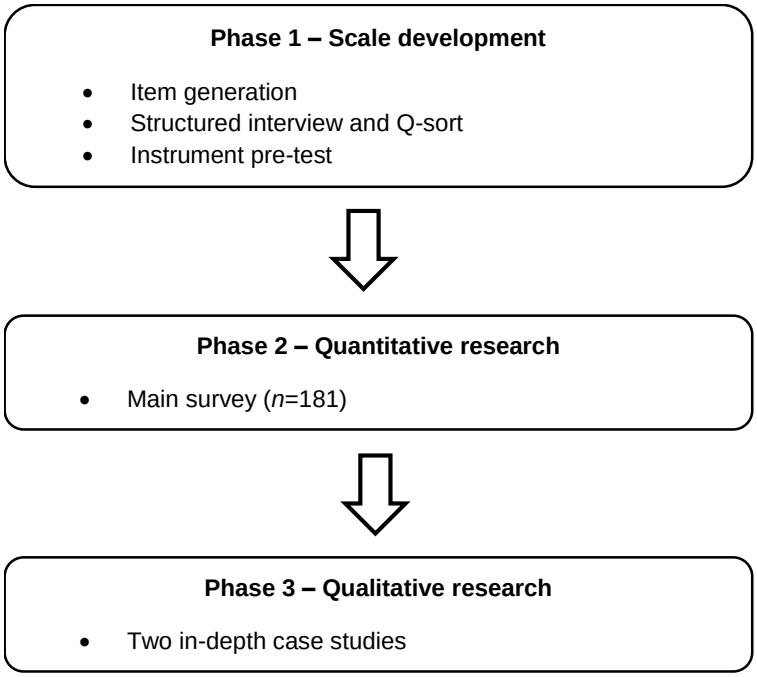


Figure 3-3: Three sequential phases of mixed methods design

This research was carried out in three sequential phases of the mixed methods design (Figure 3-3). In the first phase, a scale development of interaction capabilities was carried out. Although the concept of interaction capabilities has been developed, no pre-existing scale has been established to enable variables to be tested, as prior research on interaction capabilities is purely case-based (Johnsen and Ford, 2006; Johnsen and Tseng, 2010; Ngugi *et al.*, 2010; Cui and Hertz, 2011; Talay and Dean, 2012). In this research, the scale development steps of item generation, structured interview and Q-sort, and scale pretest, which aligned closely with the steps set out by Cao and Zhang (2011), were followed. The interaction capability scale developed in this study will be useful to both industry and academics. For SMEs, the reliable and validated scale can serve as an effective tool to assess their current level of interaction capabilities, whereas scholars can use the validated scale in further studies of interaction capabilities.

Exploiting the benefits of survey research, a survey questionnaire was employed to expand the studies of interaction capabilities by collecting data from a large population (Malhotra and Grover, 1998). By using this method, relationships between variables could be examined and generalisation of findings could be made from the sample of the population.

This was followed by the third phase, a qualitative approach covering two case studies in the UK; the case studies were undertaken to seek explanations of the quantitative data (Oke, 2003; Yeung, 2008). A qualitative approach could not be carried out either by clinical research, as the research was not initiated by the company representative, or action research, as the project was not originated by a particular organisation (Karlsson, 2016). The project was initiated by the researcher with the aim of exploring the role of interaction capabilities in increasing the participation of SMEs with their larger customers' SCs. Triangulation of quantitative and qualitative data used in this study would overcome the bias issues that may have arisen from a single approach (Choi *et al.*, 2016).

3.4 Phase 1 – Scale development

As interaction capabilities research has been dominated by case studies, no pre-existing scale for those capabilities was found. Hence, a scale development of interaction capabilities was developed that involved a number of stages, as illustrated in Figure 3-4. The first step involved an item generation with the aim of achieving content validity of the items; these items were generated through a thorough literature review. This step was followed by a structured interview and Q-sort, in which inter-rater reliabilities were assessed at the end of each round. The third step related to an instrument pretest, which was conducted in two phases. In the first phase, it was pretested with academicians so as to obtain feedback on the clarity, understanding and relevance of the measurement items, while, in the second phase, the instrument was pilot tested on target respondents.

In early research on OM, reliable and valid scales were still lacking (Hensley, 1999). Hensley (1999) claimed that only six published studies from 1989 to 1996 have described a complete scale development process, as presented in Figure 3-4. Thus, these studies in the 1990s, as well as those in the 2000s were used in order to provide guidelines, as shown in Tables 3-2 and 3-3. As for interaction capabilities, new scales were developed. Prior to developing new scales, two caveats of *ad hoc* scales were considered. Firstly, whether existing well-validated scales for a particular construct should be used rather than creating a new one. Secondly, *ad hoc* scales should be evaluated psychometrically, involving validity evidence that is more than just face validity. This means researchers should not

limit themselves to the domain coverage of a particular construct, instead other validity tests such as convergent and discriminant validity tests should also be conducted for the new scales. This is because these validity tests assess whether the construct is distinct and items within the construct converge (Furr, 2011).

To fulfil the first caveat, OM and marketing literature were reviewed and no pre-existing scales of interaction capabilities were found. Moreover, scales related to the HIC construct such as knowledge, skills and expertise, TIC construct such as IT skills and technical systems, MIC construct such as structures, collaboration and strategies, and CIC construct such as culture and values, were examined. However, the scales contained items that did not emphasise relationship-specific properties. For example, human capability scales consist of items related to attributes of a person (e.g., “skills are picked up rather than learned systematically and people are not encouraged to update/increase their skills”) which may represent management and workforce incompetence (Gilgeous, 1995). In another example related to cultural capability, the items include beliefs and values within an organisation (e.g., “organisational values are inconsistent” and “top management fails to demonstrate belief/commitment in plans”) concerning how work should be organised (Gilgeous, 1995). This suggests that these items focus on firm-specific but lack inter-firm or relationship-specific properties. As this thesis focused on an SME as the unit of analysis and inter-firm relationship with larger customers as the unit of reference, scales related to SME capabilities with reference to its relationships with larger customers were required. Therefore, to account for the limitations of pre-established scales, new scales were developed.

Moreover, research based on psychology has been referred to as well, as most of the OM studies in the early 1990s had borrowed established techniques used by mature fields such as psychology. However, the main reference for this instrument development was from Cao and Zhang (2011, 2013) on supply chain collaboration (SCC) because of interrelated topics between SCC and buyer-supplier relationships in which the collaboration topic is also emphasised in buyer-supplier relationships.

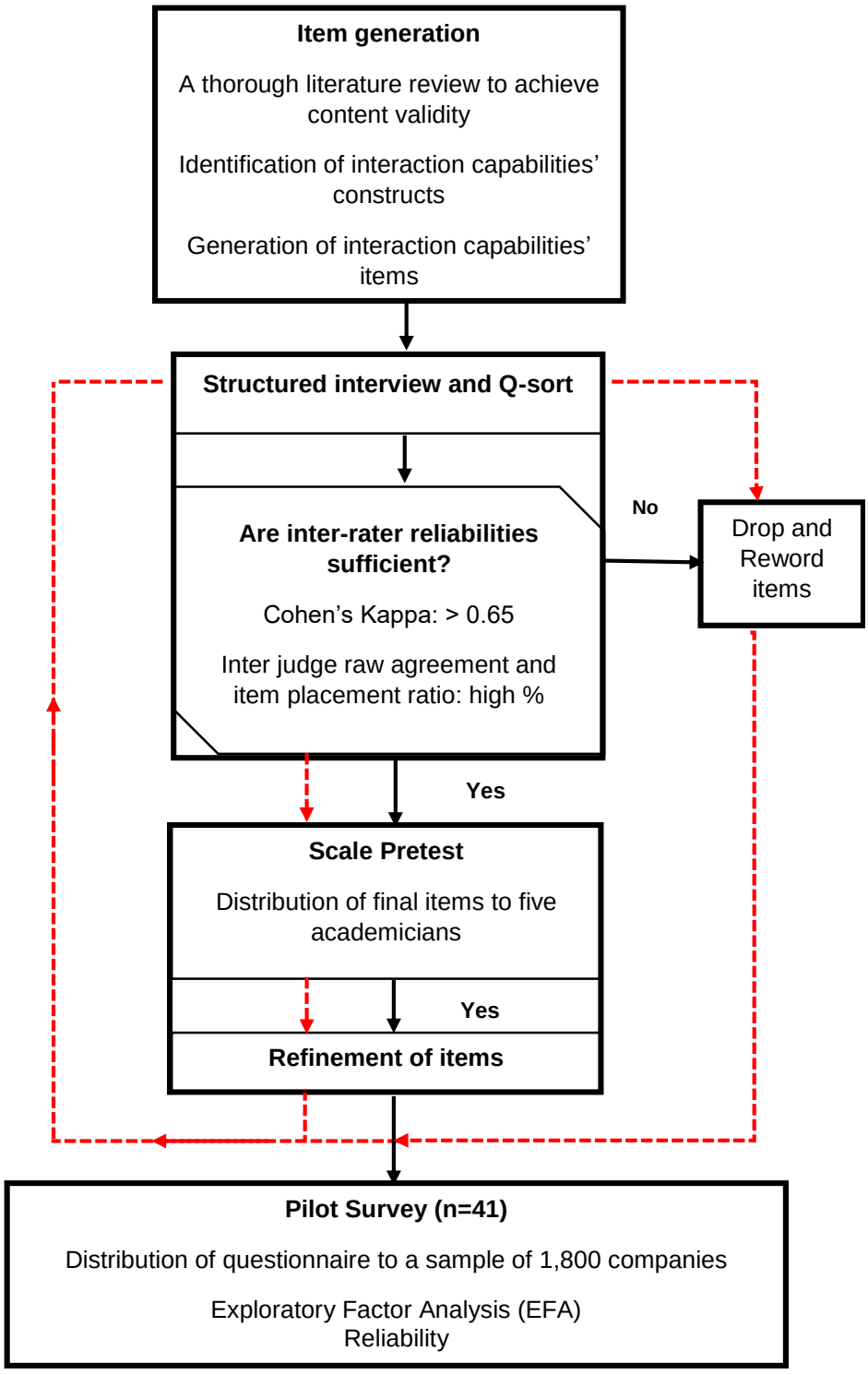


Figure 3-4: Scale development steps

Table 3-2: Scale development studies from 1989 to 1996

	Saraph, Benson and Schroeder (1989)	Sakakibara, Flynn and Schroeder (1993)	Flynn, Schroeder and Sakakibara (1994)	Ward, Leong and Boyer (1994)	Black and Porter (1996)	Ahire, Golhar and Waller (1996)
Journal	Decision Sciences	Production and Operations Management	Journal of Operations Management	Decision Sciences	Decision Sciences	Decision Sciences
Construct	Quality management	Just-in-time	Quality management	Manufacturing proactiveness	Total quality management (TQM)	TQM
Initial item generation	Literature review	Literature review Plant visits	Literature review Plant visits	Literature review	Literature review	Literature review
Questionnaire sorting	Not described	Not described	Not described	Not described	Not described	Not described
Empirical work (No. of responses)	162	822	716	60	204	371

Table 3-3: Scale development studies from 2004 to 2015

	Yang, Jun, and Peterson, (2004)	Li, Rao, Ragu-Nathan, and Ragu-Nathan (2005)	Swafford, Ghosh, and Murthy (2006)	Menor and Roth (2007)	Cao and Zhang (2011)	Zhao, Huo, Selen, and Yeung (2011)	Ambulkar, Blackhurst, and Grawe (2015)
Journal	International Journal of Operations and Production Management	Journal of Operations Management	Journal of Operations Management	Journal of Operations Management	Journal of Operations Management	Journal of Operations Management	Journal of Operations Management
Construct	Online service quality	Supply chain management (SCM) practices	Supply chain agility	New service development	SCC	Supply chain integration	Firm resilience Risk management
Initial item generation	Content analysis	Literature review	Literature review	Literature review In-depth discussions with executives	Literature review Discussions with academic and industrial experts	Literature review	Literature review
Questionnaire sorting	Not described	Yes	Yes	Yes	Yes with structured interview	Not described	Not described
Instrument pretest	1st phase - nine (five academics, four local professionals) 2nd phase – 50 online customers	Six academicians Three structured interviews	Not described	Not described	Not described	15 companies	11 (six faculty members,15 industry experts)
Empirical work (No of responses)	235	196	121	168	211	617	199

3.4.1 Item generation

The first step in the scale construction is usually item generation, with the purpose of achieving content validity (Cao and Zhang, 2011). Content validity indicates whether the measurement items adequately represent the constructs, which is the emphasis of the early stage of scale development (Churchill, 1979). Hinkin (1995) has highlighted the importance of generating sound measures due to two keys concerns:

a) lack of content validity in some of the early measures, and

b) the way researchers describe the item generation process may sound like a disservice due to the absence of useful information regarding the antecedents of measures.

Thus, it is important for researchers to go through a thorough process as this will influence the measurement model results. The process can be conducted either inductively or deductively (Hinkin, Tracey and Enz, 1997). The inductive approach uses a theory to define the construct and develop items based on the definition. For theory that is undeveloped, the process of identifying the items can include contacting practitioners to obtain feedback about how the construct is viewed in the organisation and capturing any important aspects of the industry being studied (Hensley, 1999). In the deductive approach, a theoretical definition of a construct is used to derive the items. Here, an understanding of the relevant literature and phenomenon under study is required (Hinkin *et al.*, 1997). Both of these approaches may then be subjected to a sorting process, permitting items that are deemed conceptually inconsistent to be deleted (Hinkin, 1995).

In previous studies, a variety of methods, such as literature review, plant visits and interviews, or in-depth discussions, were used to generate items for particular constructs. Generally, the main reference for item generation is through an extensive literature review. In early studies, TQM and JIT, plant visits and in-depth discussions have all been used to complement the review of the literature (Sakakibara *et al.*, 1993; Flynn *et al.*, 1994; Menor and Roth, 2007).

In this study, an inductive approach was used. Based on theory, constructs (HIC, TIC, MIC and CIC) were defined and items generated through the findings of the

prior research on interaction capabilities. Findings that met the definitions of each interaction capability were chosen and used as questionnaire items. For example, in a research conducted by Johnsen and Ford (2006), findings from one of the participants highlighted that “senior staff and innovative graduates work with customers to build new/common areas of expertise”. As this finding met the definition of HIC, this statement was used to build an HIC item, “working with larger customers to build new or common areas of expertise”. In another example, one of the participants in Ngugi *et al.'s* (2010) study mentioned “development of business plans in collaboration with larger customers”. As this finding aligned with the MIC definition, it was used to build the MIC item, “developing business plans in collaboration with larger customers”. This finding enabled 48 initial items to be generated for different aspects of interaction capabilities. The 48 items included 11 for HIC, 13 for TIC, 12 for MIC and 12 for CIC, as represented in Table 3-4. In the next step, structured interviews and Q-sort with the practitioners and academics were carried out.

Table 3-4: Constructs and no. of items

Constructs	No. of items
HIC	11
TIC	13
MIC	12
CIC	12
Total	48

The firm level of effectiveness on 48 interaction capabilities’ items was rated against its major competitors, which follows the prior precedent of assessing firms’ capabilities. Table 3-5 presents the precedent of prior research that examines firm’s capabilities against its competitors (Kim, 2006; Alegre, Sengupta and Lapiedra, 2011; Kim *et al.*, 2011; Pavlou and El Sawy, 2011; Wamba *et al.*, 2017).

A seven-point Likert scale was used to allow a firm to rate its effectiveness of interaction capabilities in relation to its major competitors, where 1=not effective at all to 7=extremely effective (Ahire *et al.*, 1996). A higher number of points was used as it could help improve the reliability of scales. Providing adequate variance to the respondents is considered to be one of the crucial parts in composing a questionnaire (Hinkin, 1995; Hensley, 1999; Brandon-Jones, 2017).

Table 3-5: Precedents of prior research that examine a firm's capabilities against its competitors

Measurement items	Reference	Scale	Journal	ABS ranking (2018)
Machine flexibility, Labour flexibility, Material handling flexibility, Routing flexibility, Volume flexibility, Mix flexibility	Zhang, Vonderembse and Lim (2003)	These items measure manufacturing flexibility capability compared with competitors using a five-point Likert-type scale to indicate the extent to which the respondents agree or disagree with each statement: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree. These items entered the large-scale study.	Journal of Operations Management	4*
Technical capability, Structural capability, Logistics capability, Cost leadership, Customer service, Innovative marketing technology, Differentiation	Kim (2006)	The level of emphasis on each of 20 variables was measured by a subjective rating relative to major industry competitors on a seven-point scale.	International Journal of Operations and Production Management	4
Product quality, Delivery speed, Delivery lead time, Low cost	Kristal, Huang and Roth (2010)	Please indicate your assessment of the strength of your business unit for each capability relative to your competitors' in the same markets over the past 12 months. Please think of your primary product(s) while answering these questions (1 = relatively weak, 3 = average, 5 = market leader).	Journal of Operations Management	4*
External learning competence, Internal learning competence	Alegre, Sengupta and Lapiedra (2011)	Please state the performance of your company as compared with your competitors in the following terms…	International Small Business Journal	3
Process-oriented dynamic capabilities	Kim *et al.* (2011), Wamba *et al.* (2017)	Our company is better than competitors in …	Journal of Business Research	3
Sensing capability, Learning capability, Integrating capability, Coordinating capability	Pavlou and El Sawy (2011)	Please rate the effectiveness by which your work unit reconfigures its operational capabilities in the NPD process to address rapidly changing environments relative to your major competitors.	Decision Sciences Journal	3

3.4.2 Structured interview and Q-sort

The next step in the scale construction was the structured interview and Q-sort. Four rounds of structured interviews and Q-sort were conducted to pre-assess the reliability and construct validity of the items (Moore and Benbasat, 1991; Li *et al.*, 2005; Cao and Zhang, 2011, 2013). This process also served as a pretest to remove items that were considered inconsistent with theory (Hinkin, 1995). Several procedures were involved at this stage. Firstly, the process began with structured interviews in which a conceptual model and definition of each construct were presented to the interviewees who acted as judges. Two judges were involved at each round. The judges were selected based on:

i. prior knowledge or experience working within SMEs for more than four years or
ii. own an enterprise or
iii. currently work in an SME company

The purpose of conducting structured interviews was to assess the clarity of the conceptual framework, research constructs and their definitions (Li *et al.*, 2005; Cao and Zhang, 2011, 2013). Secondly, the interviewees were required to sort the questionnaire items, which were printed on a 7 x 7-inch index card, into relevant constructs: HIC, TIC, MIC and CIC. An additional item of “Not Applicable” was added as a new construct to ensure that the interviewees were not compelled to place any irrelevant items to particular constructs. Before the Q-sort started, judges were allowed to ask questions about the framework, definitions, questionnaire items and procedures.

After each round of Q-sort, three measures of inter-rater reliabilities were used: inter-judge raw agreement, item placement ratio and Cohen’s Kappa. Firstly, the inter-judge raw agreement was measured by calculating the number of items that both judges agreed to place into a particular construct and dividing this by the total number of items, regardless of whether it was a correct construct. A higher construct validity is achieved when there is a higher degree of ‘correct placement’, which is likely to produce good reliability scores (Moore and Benbasat, 1991). Secondly, item placement ratio, which was the opposite of the inter-judge raw

agreement, could be obtained by calculating the number of items that each judge placed into a target construct and dividing by twice the total number of items. The higher degree of inter-judge agreement was considered to be achieved when there was a higher percentage of correct placement items within the target construct (Moore and Benbasat, 1991). Next, the agreement of the two judges in each round was assessed through Cohen's Kappa; their level of agreement was measured by adjusting the observed proportional agreement to take account of the agreement, which would have been achieved by chance (Cohen, 1960). Cohen's Kappa can be accepted if the scores are greater than 0.65 (Landis and Koch, 1977; Moore and Benbasat, 1991).

In the first round of this stage, a Chief Technology Officer from the HVM Catapult in WMG and a Principal Teaching Fellow of Leadership, Change and Personal Development were selected as judges. The judges were required to sort a total of 48 items for HIC, TIC, MIC and CIC. For this round, the inter-judge raw agreement score was 79% (Table 3-6). The overall item placement ratio was 80% with HIC, MIC and CIC scoring 77%, 79% and 75% respectively, indicating a low degree of inter-judge agreement, as tabulated in Table 3-7 (Moore and Benbasat, 1991). The Cohen's Kappa score averaged 72%. Referring to guidelines by Landis and Koch (1977), the score of 0.72 was considered to be substantial. Based on these results, several ambiguous items were dropped and reworded before the next pool. Four items were dropped because they were placed into different constructs by both judges. In addition, one item from the HIC construct was moved to the MIC construct, because both judges placed the item into MIC. The item was "*We have a close dialogue with larger customers"*. This made 44 items to be submitted to the next round of Q-sort.

Table 3-6: Inter-judge raw agreement scores: First round

		Judge 2						
		HIC	TIC	MIC	CIC	NA	Total	%
Judge 1	HIC	9		3	2		14	64
	TIC		11				11	100
	MIC	3		10			13	77
	CIC				8		8	100
	NA		1	1			2	
	Total	12	12	14	10		48	
Total no. of placements: 48			Number of agreements: 38			Agreement ratio:79%		

Table 3-7: Items placement ratios: First round

Constructs		Actual						
		HIC	TIC	MIC	CIC	NA	Total	%
Theoretical	HIC	17		5			22	77
	TIC		23	1		2	26	88
	MIC	5		19			24	79
	CIC	4		2	18		24	75
Total items placement: 96			Hits: 77			Overall hit ratio: 80%		

After dropping and rewording several items in the first round, a total of two new judges from an electronics manufacturing industry and a Principal Teaching Fellow of People and Management were recruited, in order to sort 44 items; nine items of HIC, 12 items for TIC construct, 13 items represented MIC and ten items of CIC in the second round. The results are presented in Tables 3-8 and 3-9. As shown in Table 3-8, the inter-judge raw agreement score was 73%, i.e. lower than the first round.

Table 3-8: Inter-judge raw agreement scores: Second round

	Judge 2							
Judge 1		HIC	TIC	MIC	CIC	NA	Total	%
	HIC	8	2	3	1		14	57
	TIC	3	8	2			13	62
	MIC			8	1		9	89
	CIC				8		8	100
	NA							
	Total	11	10	13	10		44	
Total no. of placements: 44			Number of agreements: 32			Agreement ratio: 73%		

Even though the overall items placement ratios showed a 2% improvement from the first round, the HIC construct was quite poor at 64% which was unacceptable, as presented in Table 3-9.

Table 3-9: Items placement ratios: Second round

Constructs		Actual						
		HIC	TIC	MIC	CIC	NA	Total	%
Theoretical	HIC	16	3	3	3		25	64
	TIC	2	20	1			23	87
	MIC		1	20	1		22	91
	CIC			2	16		18	89
Total items placement: 88			Hits: 72			Overall hit ratio: 82%		

Kappa's result was still considered substantial, although it dropped to 64% (Landis and Koch, 1977). It was realised that some of the items did not reflect the 'ability' of the firms. Thus, in order to obtain better results in the next round, several changes were made by refining the items and removing the name of the constructs, as shown in Table 3-10.

Table 3-10: Changes in structured interview and Q-sort round

Round 1	Round 2	Round 3	Round 4
Human The ability of SMEs' employees to develop, combine and use knowledge within customer relationships 11 items	Human The ability of SMEs' employees to develop, combine and use knowledge within customer relationships Nine items	The ability of SMEs' employees to develop, combine and use knowledge within customer relationships Eight items	The ability of an SME to develop, combine and exchange knowledge, skills and expertise with larger customers Four items
Technological The ability of SMEs to open up to technological innovation, combine existing technologies and collaborate on new technological configurations with larger customers 13 items	Technological The ability of SMEs to open up to technological innovation, combine existing technologies and collaborate on new technological configurations with larger customers 12 items	The ability of SMEs to open up to technological innovation, combine existing technologies and collaborate on new technological configurations with larger customers 12 items	The ability of SMEs to open up to technological innovation, combine existing technologies and collaborate on new technological configurations with larger customers Seven items
Managerial systems The ability of SMEs to operate effectively with larger customers through different relationship approaches 12 items	Managerial systems The ability of SMEs to operate effectively with larger customers through different relationship approaches 13 items	The ability of SMEs to operate effectively with larger customers through different relationship approaches Nine items	The ability of an SME to plan and collaborate with larger customers at a strategic level Six items
Cultural The ability of SMEs to develop and manage cross-cultural relationships 12 items	Cultural The ability of SMEs to develop and manage cross-cultural relationships. 10 items	The ability of SMEs to develop and manage cross-cultural relationships 10 items	The ability of an SME to learn and be tolerant of larger customers' culture and values Six items

The items refinement involved adding words such as "*able to*", "*effective at*", and "*good at*" to reflect the "*ability*" of the firms. The rewording involved a slight change to the items as shown by the italicised words below:

1st and 2nd round: We work with larger customers to build new or common areas of expertise.

3rd and 4th round: We *are able* to work with larger customers to build new or common areas of expertise.

Based on the changes, 25 items were reworded and five items were dropped. In total, 39 items; eight, 12, nine and 10 items representing HIC, TIC, MIC and CIC constructs respectively were submitted to the third round of Q-sort.

In the third round, two new judges, an Innovation Manager and a Technology Transfer Engineer from WMG HVM Catapult who were significantly involved in innovation in SMEs were chosen to sort 39 items. Unfortunately, all the three measures were poorer than expected and even lower than the first two rounds. The inter-judge raw agreement score was 46% (Table 3-11).

Table 3-11: Inter-judge raw agreement scores: Third round

		Judge 2						
Judge 1		HIC	TIC	MIC	CIC	NA	Total	%
	HIC	3	1				4	75
	TIC		10	1		1	12	83
	MIC	6	3	3	5		17	18
	CIC			4	2		6	33
	NA							
	Total	9	14	8	7	1	39	
Total no. of placements: 39			Number of agreements: 18			Agreement ratio: 46%		

The items placement ratios score averaged 68% (Table 3-12), which showed a lower degree of inter-judge agreement.

Table 3-12: Items placement ratios: Third round

Constructs		Actual						
		HIC	TIC	MIC	CIC	NA	Total	%
Theoretical	HIC	9	3	3		1	16	56
	TIC		22	2			24	92
	MIC	4	1	11	2		18	61
	CIC	9			11		20	55
Total items placement: 78			Hits: 53			Overall hit ratio: 68%		

In addition, Cohen's Kappa score was only 28% which represented a fair agreement between the judges (Landis and Koch, 1977). Based on the feedback from the judges, two primary concerns were identified:

a) ambiguous triggering words and
b) items that did not correspond to the definition. These confused the judges, which then led to poor results.
One of the items was "*We learn a lot from visits to our larger customers' premises*". The ambiguous triggering word of "*visits"* instead of the triggering word "*learn"* led the judges to place it onto the TIC construct instead of the HIC construct.

Furthermore, judges had difficulty distinguishing between HIC and MIC items. To account for this shortcoming, numerous changes were undertaken involving amending the definition of the MIC construct to make it distinct from the HIC construct. With this new definition, six items were dropped, two original items were reworded and remained, and nine new items of MIC construct were created. Other items from the other three constructs were kept to the next stage. As the third round results did not meet acceptable scores, a total of 42 items were submitted for instrument pretest, rather than for the next round of Q-sort, as presented in red arrows in Figure 3-4. In a standard process, each round should meet the acceptable scores of inter-rater reliabilities before moving to the instrument pretest, as illustrated in black arrows in Figure 3-4. The instrument pretest is explained in the next sub-section.

Once the items were dropped and modified based on the feedback from the pretest, the Principal Teaching Fellow of People and Management from the second round and the Innovation Manager from the fourth round were recruited again to sort 23 items. The feedback from the instrument pretest enabled good results to be produced; the inter-judge raw agreement score was 91% (Table 3-13) which confirmed the higher construct validity of the items.

Table 3-13: Inter-judge raw agreement scores: Fourth round

		Judge 2						
Judge 1		HIC	TIC	MIC	CIC	NA	Total	%
	HIC	3					3	100
	TIC	1	6				7	86
	MIC			6			6	100
	CIC	1			6		7	86
	NA							
	Total	5	6	6	6		23	
Total no. of placements: 23			Number of agreements: 21			Agreement ratio: 91%		

The item placement ratio score was at 96% (Table 3-14) with each construct showing higher scores, denoting a higher degree of inter-judge agreement. The Cohen's Kappa score was an almost perfect strength of agreement at 88% (Landis and Koch, 1977). The final measurement items are presented in Appendix A. From the results, 29 final items were used for the next stage which was pilot testing.

Table 3-14: Items placement ratios: Fourth round

Constructs		Actual						
		HIC	TIC	MIC	CIC	NA	Total	%
Theoretical	HIC	7			1		8	88
	TIC	1	13				14	93
	MIC			12			12	100
	CIC				12		12	100
Total items placement: 46			Hits: 44			Overall hit ratio: 96%		

3.4.3 Scale pretest

As mentioned in Section 3.4.2, after the third round of the structured interview and Q-sort, an instrument pretest was conducted to ensure the content validity of the items. Hensley (1999) has claimed that instrument pretesting may serve the same purpose as sorting, while Forza (2002) points out that instrument pretesting should be done in two phases with each having two distinct yet complementary objectives. Thus, two phases of instrument pretest were carried out. The first phase involved five academics who have experience in both survey design and the entrepreneurship research context. The academicians were required to indicate which items should be kept, dropped or modified, according to the following criteria:

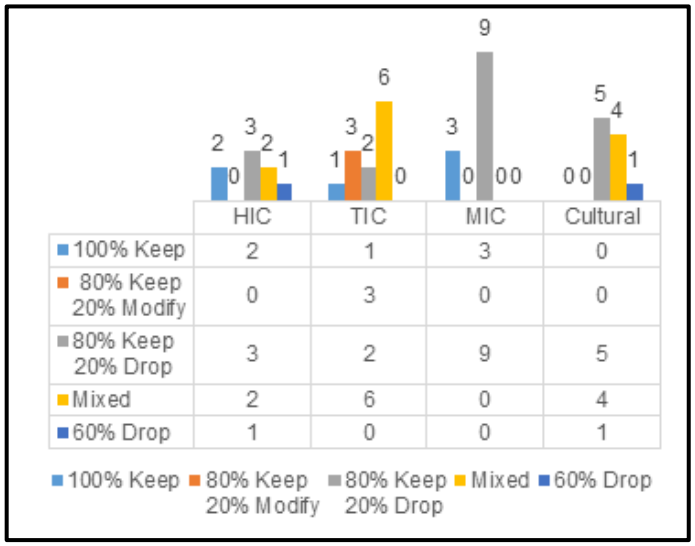
a) how well they reflect their respective interaction capabilities,
b) how well they correspond to the definitions,
c) how intelligible they are, and
d) how well they cover their respective construct.

Based on these criteria, mixed results were achieved, which could be classified into five categories, as illustrated in Figure 3-5:

a) all the academics i.e 100% of them agreed to keep the items
b) 60% of them agreed to drop the items
c) 80% indicated to keep, with 20% indicated to drop
d) 80% opted to keep, with 20% opted to modify

e) mixed results, such as 60% indicated to keep, 20% indicated to drop and 20% indicated to modify.

Of these five categories, “a” and “d”, were excluded from the fourth Q-sort, because the majority of the experts agreed to keep the items, or the items required little modification. In addition, a total of 11 items from the four constructs were dropped for the next stage, based on the feedback from the experts. As a result, 23 items were included in the fourth round of structured interview and Q-sort.



	HIC	TIC	MIC	Cultural
100% Keep	2	1	3	0
80% Keep 20% Modify	0	3	0	0
80% Keep 20% Drop	3	2	9	5
Mixed	2	6	0	4
60% Drop	1	0	0	1

Figure 3-5: Instrument pretest results from the experts

In the second phase, the instrument was pilot-tested with targeted respondents. The purpose of conducting the pilot survey was to validate the instrument by carrying out preliminary analysis of the data. As Forza (2002) perceptively states, the analysis can help researchers to investigate whether:

a) the choice of scale leads to answers to certain questions being too focused

b) the content of the answers varies from what was anticipated, and

c) the context alters the appropriateness of questions, such as questions only relevant to LEs not SMEs or only meaningful to the manufacturing industry and not to the services industry.

The instrument pretest also helped to identify a remarkable number of problems, although a number of measures had been adopted prior to the pilot test. This step, however, is not usually performed in OM research (Forza, 2002). By performing

two phases of instrument pretest, this could confirm the high content validity of the instrument.

The study has been conceptualised to explore the role of interaction capabilities in increasing SMEs' participation in larger customers' SCs. Thus, the unit of analysis was an SME. Within the European Commission, an SME can be defined by three criteria: a) staff headcount, b) annual turnover, and c) annual balance sheet total. SMEs can be categorised into micro-, small- and medium-sized enterprises. Referring to Table 3-15, micro enterprises are defined as enterprises with fewer than 10 persons and whose annual turnover or annual balance sheet total does not exceed EUR 2 million. On the other hand, small enterprises are those that employ fewer than 50 persons and their annual turnover or annual balance sheet does not exceed EUR 10 million, whereas medium-sized enterprises are defined as enterprises with fewer than 250 employees and either have an annual turnover that does not exceed EUR 50 million, or an annual balance sheet of less than EUR 43 million (European Commission, 2005).

Table 3-15: SME definition

Enterprise category	Headcount: annual work unit (AWU)	Annual turnover		Annual balance sheet total
Medium-sized	< 250	≤EUR 50 million	or	≤EUR 43 million
Small	< 50	≤EUR 10 million		≤EUR 10 million
Micro	< 10	≤EUR 2 million		≤EUR 2 million

In this pilot study the number of employees or annual turnover are the main reference point. The questionnaire was distributed to 41 managers of UK small- and medium-sized companies using an online survey tool called Qualtrics, which is an experience management platform designed to allow researchers to gather, analyse and share data with the teams. It has wide university collaborations that allow the research to be shared with colleagues from other universities. With Qualtrics, the survey could be reviewed by supervisors using a single platform. The respondents were identified and randomly selected via a database called Data-HQ. This database was purchased for the purpose of accessing the corporate mailing lists as it provides comprehensive mailing lists of SMEs and larger companies in the UK. The database allows clients to identify prospective companies according to various criteria such as business type, job title, geography, size, turnover, email and other relevant data.

A sample of 41 was deemed sufficient because the ratio of sample size, *N,* to the number of variables being analysed, *p,* which is also known as the *N:p* ratio for individual factors, was satisfied. A ratio 5:1 was used and sufficient, as factor analysis was conducted on individual constructs, most of which were below eight items, except for MIC with nine items. For a proper exploratory factor analysis (EFA) to take place, a larger sample was ideally required, but that would have reduced the pool of respondents for the main study considerably. So, this choice was made for pragmatic reasons. There are many recommendations regarding the minimum sample size and ratio in factor analysis. Research by MacCallum *et al.* (1999) has stated that all the rules of thumb regarding the minimum level of *N* and minimum *N*:p ratio were invalid as they were not consistent across studies; instead, they depend on some facets of the variables and design of the study. Nonetheless, a ratio of 5:1 was used as a guideline in this study. The respondents were identified and randomly selected using the following criteria:

a) the size of the company (micro-, small- and medium-sized)
b) geographical market based in the UK
c) HVM sector.

The HVM sector included 10 selected standard industrial classification (SIC) codes of: chemical and chemical products (20); basic pharmaceutical products and pharmaceutical preparations (21); weapons and ammunition (25.4); computer, electronic and optical products (26); electrical equipment (27); machinery and equipment (28); motor vehicles, trailers and semi-trailers (29); railway locomotives and rolling stock (30.2); air and spacecraft and related machinery (30.3); and military fighting vehicles (30.4) (TSB, 2012). The SIC code was used to classify the type of economic activity in which SMEs were engaged. Thus, the latest revision of SIC 2007 was used for this research (BIS, 2015; Companies House, 2015).

Table 3-16 presents the demographic profile of the pilot survey respondents, reflecting the diversity of the respondents in terms of size of the company and industry. The majority of the respondents were small- and medium-sized companies with both sizes represented by 39%. This followed by micro companies (19.5%) and large companies (2.4%). Although the number of employees within the large companies was over 250, these companies satisfied the second criteria

of SME, which is the annual turnover. The respondents were represented by a wide variety of industries, with about 29.3% coming from industrial and mechanical equipment, about 17.1% of them were electronics manufacturers and 9.8% out of 41 respondents were from the chemicals industry. As for the management level, 73% of the respondents were executives responsible for the businesses.

Table 3-16: Demographic profile of the pilot survey respondents

No of employees	Number	Percentage
1-9	8	19.5
10-50	16	39.0
51-250	16	39.0
251-500	1	2.4
Annual turnover	Number	Percentage
£2 million or less	14	34.1
£2 million - £10 million	12	29.3
£10 million - £50 million	11	26.8
£50 million - £100 million	1	2.4
More than £500 million	3	7.3
Industry	Number	Percentage
Electronics	7	17.1
Industrial and mechanical equipment	12	29.3
Automotive	1	2.4
Rubber and plastics	3	7.3
Electrical equipment	1	2.4
Energy, utilities and mining	1	2.4
Chemicals	4	9.8
Aerospace, defence and security	1	2.4
Engineering and construction	1	2.4
Pharmaceuticals	3	7.3
Others	7	17.1
Management level	Number	Percentage
Junior management	1	2.4
Middle management	3	7.3
Senior management	7	17.1
Executive	30	73.2

The obtained data were subjected to factor analysis and reliability analysis. They were used to examine the stability of the scales (Hinkin, 1995). The Statistical Package for the Social Sciences (SPSS) program, version 24, was employed to analyse the data of 41 respondents. Due to the small sample size, factor analysis and reliability were conducted on individual constructs; HIC, TIC, MIC and CIC. Factor analysis was employed in this study as it serves two main purposes:

a) to identify the structure of the latent variables HIC, TIC, MIC and CIC, and
b) to reduce the number of items as some of the items might have a multicollinearity problem (Field, 2009).

Significant use of factor analysis in the stage of scale construction has also been mentioned in other studies (Hinkin, 1995). In adopting factor analysis, researchers often face the dilemma of which type of factor analysis to use in this scale development process: EFA or confirmatory factor analysis (CFA). EFA is used to explore the structure of the observed variables which can help to propose a measurement model. In contrast, CFA is applied to validate the measurement model where a researcher is interested in hypotheses testing (Field, 2009; Hair *et al.*, 2010). Hence, EFA was favoured over CFA as hypothesis testing was not relevant at this stage. This method has also been applied in other instrument development studies (Ward, Leong and Boyer, 1994; Ahire *et al.*, 1996; Black and Porter, 1996; Brandon-Jones, 2017).

When applying EFA, several procedures need to be taken into consideration. As EFA was run on individual constructs, the same procedure was applied to all. One study has recommended principle components factor analysis with a varimax rotation method to be used (Hensley, 1999). However, in this study, a principal axis factoring (PAF) with varimax (orthogonal) rotation method was used. A PAF was deemed appropriate in this context as it determined the structure that would be used in the later stage through exploring the structure of each variable and confirming it against the previous literature. Principal component analysis (PCA), on the other hand, focuses on determining which linear components exist within the data. Kaiser's criterion of eigenvalues greater than one was referred to when extracting the factors, as this criterion has been commonly used and is able to produce an accurate result for variables less than 30 and when the communalities results after extraction are greater than 0.70 (Hinkin, 1995; Field, 2009).

In identifying poor loadings items, an absolute value of greater than 0.50 was considered as significant. There are many studies that determine the minimum cut-off of the loading; however, there seems to be no acceptable cut-off value among the researchers. Studies have argued that 0.40 is the lowest acceptable threshold, as items with factor loadings of less than 0.40 are often removed from the analysis. This indicates the acceptable limit to be as low as 0.40 and it is also the criterion most widely mentioned (Sakakibara *et al.*, 1993; Hinkin, 1995; Matsunaga, 2011). Matsunaga (2011) further clarified that a 0.60 or 0.70 factor loading should be used

by researchers. To ensure the scale is robust, items with less than 0.50 were removed in this study. Yet, the decision was still ensured the retained and deleted items linked to both theory and empirical work. This is because deleting some of the items might change the theoretical meaning of the constructs (Hinkin, 1995).

Another appropriate measure at this stage was reliability. Reliability has been recommended as part of the testing stage of the scale construction process (Hinkin, 1995; Field, 2009). This is because reliability determines that any experiments or tests will yield the same results on repetitive runs. Generally, reliability covers two key subjects: consistency and stability of the measures (Flynn *et al.*, 1990, 1994; Hinkin, 1995). Reliability can be estimated using four common methods: retest, alternative form, split halves and internal consistency. Given the limitations of the first three measures, such as requiring the study to be longitudinal or measuring the instrument with two alternate forms, the internal consistency method was adopted as it only requires one administration (Carmines and Zeller, 1979). The internal consistency can be estimated by Cronbach's alpha and this is the popular and commonly used method in OM research (Carmines and Zeller 1979; Churchill 1979; Forza 2009). According to Nunnally (as cited in Forza, 2002, p.26), measures with alpha ≥0.80 are considered to be very reliable; accepted values with alpha ≥0.70 and alpha ≥0.60 are for newly developed scales (Flynn *et al.*, 1990).

3.5 Phase 2 – Quantitative research: Survey

3.5.1 Questionnaire design

Pre-established scales were used for the participation construct. The participation scale was adapted from McDougall and Robinson Jr. (1990) and McDougall *et al.* (1994). As mentioned in Chapter 2, forms of SMEs growth have not received adequate attention from researchers, making these two scales to be deemed appropriate to measure participation construct. To ensure the final scale covered the important aspects of the participation construct, some of the items from the pre-established scales were eliminated, and few additional items were included by the author.

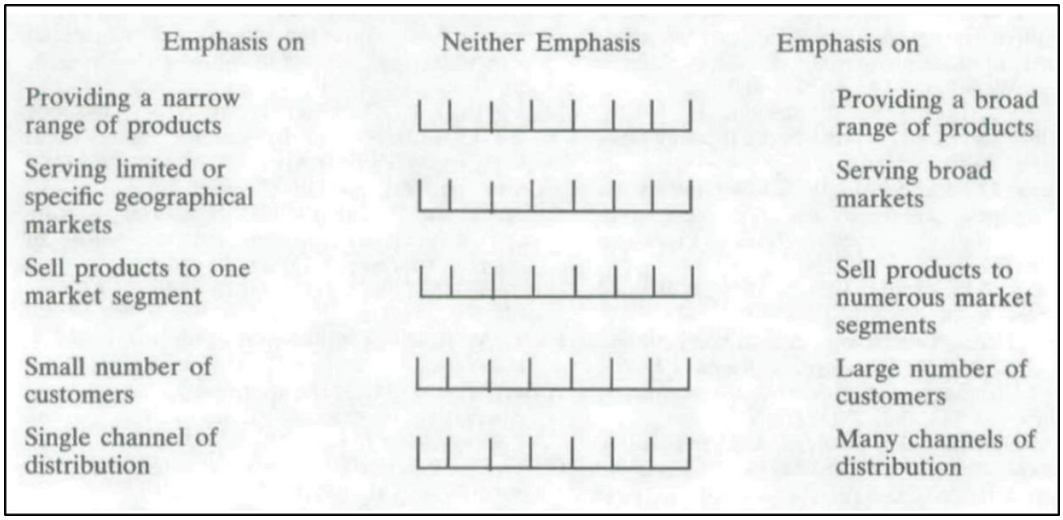


Figure 3-6: Scale (adapted from McDougall *et al.*, 1994)

From McDougall *et al.* (1994), all five items were adapted for this study, as illustrated in Figure 3-6. Out of the five items, one related to product and four to market. As the participation scale was not adequately robust to cover the domain content, literature from McDougall and Robinson Jr. (1990) was included.

Table 3-17: Participation scale

Item			Source	Remark
Providing a narrow range of products	⟺	Providing a broad range of products	McDougall *et al.* (1994)	
Providing products with narrow usage	⟺	Providing products with broad usage		Additional item by the author
Continued new product development	⟺	Maintaining current products	McDougall and Robinson Jr. (1990)	
Serving limited or specific geographical markets	⟺	Serving broad (global) markets	McDougall *et al.* (1994)	
Selling products to one market segment	⟺	Selling products to numerous market segments	McDougall *et al.* (1994)	
Small number of customers	⟺	Large number of customers	McDougall *et al.* (1994)	
Single channel of distribution	⟺	Many channels of distribution	McDougall *et al.* (1994)	
No backward integration towards suppliers and raw materials	⟺	Extensive backward integration towards suppliers and raw materials	McDougall and Robinson Jr. (1990)	
No forward integration towards customers and consumers	⟺	Extensive forward integration towards customers and consumers	McDougall and Robinson Jr. (1990)	
Narrow range of diversification into related businesses	⟺	Wide range of diversification into related businesses		Additional item by the author
Narrow range of diversification into unrelated businesses	⟺	Wide range of diversification into unrelated businesses		Additional item by the author

From the 26 items in McDougall and Robinson Jr.'s work, three additional items were used to capture product and diversification. Other items were not adapted as they were not relevant in this context or were duplicates of the McDougall *et al.* (1994) study. Moreover, three items were added to support the domain coverage of product and diversification facets. In total, 11 items made up the participation scale construct, as tabulated in Table 3-17. Following the precedent set by previous scholars, respondents were asked to place their emphasis of participation relative to their competitors (McDougall and Robinson Jr., 1990; McDougall *et al.*, 1994). Here, participation was treated as a formative construct in which product expansion, market expansion and diversification were conceptualised as

components of participation. This means they equally contribute to higher participation and do not need to be related to each other.

For firm performance, items from Droge *et al.* (1994) were used in this study as explained in Section 2.4. These items were six measures: ROI, ROI growth, market share, market share growth, ROS and ROS growth. From the SME perspective, the latter four items are hard to measure; if measurable, they will only involve a small variance which will make no difference. To ensure the items were applicable to the SME context, these four items were modified. Hence, market share and market share growth were replaced by gross income and income growth respectively.

As for ROS and ROS growth, the items were replaced by net profit and net profit growth accordingly. These changes made the firm performance more relevant to the SME context. This is consistent with a study by Biazzo and Garengo (2012), in which firm performance was established using top-down approaches to meet LEs' mission and vision. Although studies acknowledge the significance of PMSs in SMEs, a scant amount of research is available on performance measurement in SMEs, with almost no available models or approaches that can meet the diverse characteristics of SMEs. One study has revealed that two barriers hinder the implementation of performance in SMEs. These are exogenous barriers, such as lack of resources in terms of financial and human, and endogenous barriers, such as short-term strategic planning (Biazzo and Garengo, 2012). SMEs usually have no planning capabilities or they only limit the focus on performance measures to operations. As a result, they do not take advantage of implementing performance measures to introduce the strategic planning of the firm.

Table 3-18: Precedent of prior research that examines firm's performance relative to its major competitors

Measurement items	Reference	Scale	Journal	ABS ranking (2018)
Profitability, Market share, Growth rate	Deshpande, Farley and Webster (1993)	Relative to our businesses' largest competitor, we are: …	Journal of Marketing	4*
ROA After Tax, ROI After Tax, Growth in ROI, Sales growth, ROS, Growth in ROS	Vickery, Dröge and Markland (1997)	The firm's performance relative to its major competitors was assessed by the respondent on a seven-point scale with endpoints 'Worst in Industry' (= 1) and 'Best in Industry' (= 7)	Journal of Operations Management	4*
Gross profit, Net income after taxes, Total sales growth over the past three years, Overall pharmacy performance and success	McGee and Peterson, (2000)	Respondents were asked to compare their financial performance to other pharmacies using seven-point Likert type-scales ranging from "much worse" to "much better".	Journal of Small Business Management	3
Sales growth, ROS, Net profit, Gross profit	Dess and Lumpkin (2001)	Respondents are asked to evaluate firm's performance OVER THE LAST THREE YEARS *RELATIVE* TO YOUR COMPETITORS. Seven point Likert-type scales ranging from 1 "Low Performer" to 7 "High Performer" were used.	Journal of Business Venturing	4
Achieving overall performance, Attaining market share, Attaining growth, Current profitability	Reinartz, Krafft and Hoyer (2004)	Relative to your competitors, how does your strategic business unit perform concerning the following statements? (Rated on a seven-point Likert scale of "much worse", "worse," "a little worse," "same level," "a little better," "better," and "much better.")	Journal of Marketing Research	4*
Overall cost performance	Wu, Choi and Rungtusanatham (2010)	Compared with other suppliers, how does this supplier perform in the following areas? (1=Needs improvement, 7=Superior performance)	Journal of Operations Management	4*
Achieving overall performance, Attaining market share, Attaining growth, Current profitability	Mitrega *et al.* (2017)	Evaluate how your company performs concerning the following statements relative to your firm's competitors (Much worse (1) – Much better (7))	International Journal of Operations and Production Management	4
Sales growth, Profitability, ROI, Overall financial performance, Market share	Wamba *et al.* (2017)	Financial performance/ Market performance: Using analytics improved ---------- during the last three years relative to competitors	Journal of Business Research	3

The final six items of firm performance were evaluated by subjective ratings relative to major industry competitors, as justified by the precedents from the literature (Table 3-18). Here, subjective rating was adopted for three reasons. First, the objective performance of small businesses is not publicly available because owners or entrepreneurs are concerned about disclosing their objective performance measures. Moreover, if the data are available, they are inaccurate as many business owners manipulate their objective performance measures (Dess and Robinson, 1984). Second, there is concern that obtaining objective measures might reduce the response rate, as highlighted by Squire, Cousins and Brown (2009). Previous studies have reported that fewer respondents were recorded when they were asked about objective questions related to performance. It has been found that respondents are often very reluctant to reveal their confidential data (Ward *et al.*, 1994; Boyer *et al.*, 1997). Third, prior research found significant relationships between subjective and objective measures. This means that subjective measures of performance were consistent with the actual performance of the firms (Dess and Robinson, 1984; Caloghirou *et al.*, 2004). This finding suggests that subjective perceptual measures can be used if objective measures are inaccessible (Dess and Robinson, 1984). More recently, scholars like Wang *et al.*, (2012) have argued that self-reported measures were the only option to collect a firm's performance data, in view of the fact that the objective data of privately held or state owned were difficult to collect. Recently, studies such as the one conducted by Singh, Darwish and Potočnik's (2016), have confirmed the reliability and validity of the subjective measures in four different countries. They claimed that subjective performance measures can be adopted by researchers, because consistent and comparable data of objective performance are difficult to obtain across countries and sectors.

In summary, the survey instrument measured three main constructs: a) interaction capabilities, b) participation, and c) firm performance. Using data from the pilot study, several changes were made for the interaction capabilities scale based on the results from the factor analysis and reliability analysis, including removing some of the poor loading items. By combining the established scales for participation and firm performance and new scale for interaction capabilities, a final instrument for this study was then used for the large empirical work, as presented in Appendix E.

3.5.2 Sampling and data collection

The questionnaire was targeted at experienced managers who were familiar with the strategic direction of the UK SMEs. To ensure generalisability of the results, the same three criteria as the pilot were followed:
a) firm size
b) geographical market, and
c) industry sector.

As the thesis focused on SMEs, companies with more than 250 employees were excluded. These companies were required to be based in the UK and involved in the HVM industry. The same database as the pilot study, i.e. Data HQ, was obtained. After filtering all the criteria, 9,550 companies were identified. A second database of FAME, which consisted of 2,255 companies, was drawn from the Warwick University library to increase the response rate. Besides, 56 additional contacts from WMG industry collaboration and nine contacts from the Gauge and Tool Makers Association (GTMA) were obtained, which resulted in 11,870 potential respondents. Of these, 244 firms were not interested in participating (as an "unsubscribe" email was received), thus the final list resulted in 11,626 companies.

Difficulty in accessing a sample of a particular population has been recognised as one of the limitations associated with mail surveys. To improve the response rate, follow-up strategies were adopted. First, three email reminders were sent regularly after the first invitation was sent in June 2017. The initial email was sent to invite the companies to participate in the questionnaire together with the assurance of anonymity. After the first notification, reminder emails were sent biweekly to those who had not responded to the first invitation. However, no reminder emails were sent in the month of August as most of the people would be on holiday. The reminder email was continued again in September. The telephone call was another strategy adopted. As suggested by Forza (2002), this method can be a more useful way to reach respondents. Through phone calls, it could be confirmed that emails were received by the target respondents. Personal contact that was established made it easy to explain and convince them of the research efficacy.

All these efforts resulted into 205 responses received; 24 were discarded due to incomplete information, duplicates from the same company, or they did not meet the sampling criteria of firm size or industry sector. From the discarded responses, 16 responses were not listed as HVM companies but were considered usable for two reasons. Firstly, the companies involved manufacturing activities that related to HVM, such as design. Secondly, the companies served HVM sectors, such as automotive. As a result, 181 usable responses were received, which yielded a low response rate of 1.6% (181/11,626). This poor response rate is quite common for industrial research. Previous studies have indicated response rates of less than 10% such as 7.9% (Inman *et al.*, 2011), 6.3% (Li *et al.*, 2005), and 7.1% (Ellis, Henry and Shockley, 2010). While most of the prime sources of this questionnaire were the owners of the companies, their time was often occupied and their lack of resources made it hard to achieve a higher response rate. Final data received were then used for subsequent analysis.

3.5.3 Control variables

In this study, two control variables were used, the first of which was firm size. Firm size was measured as the number of employees which could be broken down into micro 1-9, small 10-50 and medium 51-250. Previous studies have shown that the larger the company, the more opportunities it has to grow its business due to having more resources than the smaller enterprises (Carr and Pearson 1999; European Commission 2014). Since it can influence the results of the study, firm size was controlled.

The second control variable was related to the industry sector, which was measured based on the R&D intensities; these were classified into four manufacturing industries; high-technology, medium-high-technology, medium-low-technology and low-technology (OECD, 2011). Industry sector and firm size were operationalised by transforming the initial categorical variables into dummies. It was important to omit one dummy from each to act as the reference category. Thus, small-sized companies and medium-high-technology were omitted as they were the highest respondents when compared to the other categories.

3.5.4 Non-response bias and common method bias tests

Non-response bias refers to the difference between respondents' and non-respondents' answers. In this study, non-response bias was assessed by identifying any significant difference between early and late respondents (Armstrong and Overton, 1977). With this method, the early 30 responses were compared against late 30 responses using *t*-Test statistics; *t*-Test was performed on all continuous variable questions. The results showed no statistically significant differences found between these two groups, suggesting non-response bias was not an issue in this research.

Since the same sources were obtained for predictor and criterion variables, it was important to check common method bias. This was checked by using Harman's single factor test, also called Harman's one factor test, which is the most widely used test (Podsakoff *et al.*, 2003). Following previous studies, the test was performed on interaction capabilities, participation and firm performance constructs using EFA. The results indicated that one single factor accounted for 26.31% of the total variance which did not explain the majority of the total variance. Hence, common method variance was not considered a problem.

3.5.5 Data analysis

Using the empirical data, the Anderson and Gerbing (1988) two-step approach was followed. In the first step, the measurement model was tested using CFA and in the second step, path analysis was used to examine the structural model. Statistical programs of Analysis of Moment Structures (AMOS) version 24 were used to test the CFA and path analysis, while SPSS version 24 was employed to analyse the descriptive data. The functions of EFA and CFA may appear similar to some extent but are different philosophically. In EFA, researchers instruct the software to identify the underlying variables for each construct while in CFA, researchers have specified the variables for particular constructs (Hair *et al.*, 2010). Since specified variables were already identified based on the EFA results in the pilot study, CFA was chosen at this stage to confirm the perceived theory. A good measurement model would depend on the goodness of fit and construct

validity. Goodness of fit compares the estimated covariance matrix theory against reality, which is the observed covariance matrix (Hair *et al.*, 2010).

3.5.5.1 Goodness of fit

The key statistical measure when comparing the estimated and observed covariance is chi-squared (χ^2). This χ^2 is highly influenced by the sample size; as the sample size increases, the value of χ^2 increases. In estimating the χ^2, researchers are interested in 'non-significance' as it is the indicator that the observed variance-covariance matrix is not significantly different from the estimated matrix. Often, it is difficult for researchers to obtain a non-significant χ^2 and assessment solely on χ^2 is complicated. Therefore, to account for χ^2 limitations, researchers have devised alternative model fit indices, which can be grouped into absolute, incremental and parsimony (Garver and Mentzer, 1999; Byrne, 2010; Hair *et al.*, 2010). Garver and Mentzer (1999) in their study have mentioned two strategies in examining the model fit: firstly, choose fit indices that represent each family; secondly, determine a strict criteria and choose fit indices that represent this criteria. They chose the second category and recommended using the Tucker-Lewis index (TLI), the comparative fit index (CFI) and the root mean square approximation of error (RMSEA) because of the following criteria:
a) these indices are defined into a continuum (0-1), making it easy for interpretation and
b) are relatively insensitive to the sample size effects.
Thus, in this study, the indices recommended by Garver and Mentzer (1999) were used as they represented each family index and are not highly influenced by the sample size. This is consistent with previous research findings, i.e. that analysts needed to report at least one fit index for each incremental and absolute fit index, in addition to χ^2 and degree of freedom, because they are often redundant. Besides, the normed χ^2 of absolute fit indices was also used because it is the most widely reported by researchers (Hair *et al.*, 2010).

The TLI is an incremental fit index that is similar to the normed fit index (NFI). It compares the proposed model to the null model and the values range from 0 to 1; a good model fit has a value closest to 1 (Garver and Mentzer, 1999; Byrne, 2010; Hair *et al.*, 2010). The CFI replaced the original incremental fit index of NFI. Of the

two, CFI is the more widely used by researchers and should be the index of choice because it is insensitive to the complexity of the model (Bentler, 1990; Byrne, 2010). Values higher than 0.90 suggest a better fit of the model (Byrne, 2010; Hair *et al.*, 2010). However, this cut-off value has been revised to 0.95 (Hu and Bentler, 1999). Researchers are often in a dilemma as to what is the acceptable value for the incremental fit estimates. In the early 1990s, an absolute value of 0.90 was the standard practice. The value was then revised to 0.95 by the end of the decade as 0.90 was deemed too low, potentially leading to bad model fit if it was accepted (Hu and Bentler, 1999). Nonetheless, Hair *et al.* (2010) argue that there is no particular value that can always distinguish good from bad models. Hence, 0.90 was used as the acceptable rule of thumb. Furthermore, the cut-off value of 0.90 was still the practice in 2000s studies (Swafford *et al.*, 2006; Jayaram, Ahire and Dreyfus, 2010; Cao and Zhang, 2011; Villena, Revilla and Choi, 2011). RMSEA is one of the most widely used fit statistics of absolute fit indices; it measures whether a model fits a population by including both model complexity and sample size in the calculation. A lower value for RMSEA is associated with a better fit model. A good RMSEA value is questionable, with many previous studies suggesting the absolute threshold for RMSEA. Hu and Bentler (1999) have indicated 0.06 to be a cut-off value for a good RMSEA. In other studies, 0.08 to 0.10 ranges are deemed acceptable as they indicate a mediocre fit (MacCallum, Browne and Sugawara, 1996); thus, a cut-off of 0.08 was used as a reference. The normed χ^2 can be calculated by dividing χ^2 by the degree of freedom. It is widely used because it can be calculated manually even if the software does not provide it. A value of less than 3.0 indicates a good model fit (Hair *et al.*, 2010).

In testing the measurement model, several diagnostic measures were used to further improve the model. The first diagnostic is the path estimates. The loadings for each of the measured items were checked to ensure no items had loadings below the cut-off value of 0.60. As a rule of thumb, loadings of 0.50 are considered as acceptable, with 0.70 or higher being the ideal case (Hair *et al.*, 2010). A loading of 0.50 can still be used as a recommended cut-off value because it is statistically significant, except that the measure has more error variance than explained variance (Hair *et al.*, 2010).

The second diagnostic is standardised residuals. Residuals are the individual variances between observed covariance terms and estimated covariance terms. Better fit is achieved when residuals are smaller. Standardised residuals are calculated by dividing raw residuals by the standard error of residuals. More attention should be given to standardised residuals greater than 4.0 as there maybe problems. However, some attention should also be given to items with standardised residuals between 2.5 and 4.0 as changes to the model may occur if other diagnostic measures highlight those two items (Hair *et al.*, 2010). Large standardised residuals items were considered to be deleted to improve the model fit.

The third diagnostic measure is modification indices. A modification index calculates all possible relationships that are not estimated in the proposed model. Significant improvement to the model fit can be made to modification indices higher than 4.0. Nevertheless, it is not recommended to make any changes to the model based solely on modification indices but rather they should be justified by theory (Hair *et al.*, 2010). Hence, larger modification indices were examined and theory was referred to before making any changes.

3.5.5.2 Construct validity

Next, construct validity was examined. Assessing the construct validity of the measurement model is one of the main objectives in CFA. Construct validity measures how well the measured items reflect the latent constructs that are assigned to them (Hair *et al.*, 2010; Forza, 2016). Construct validity is comprised of numerous types that include face validity or content validity, substantive validity, unidimensionality, reliability, convergent validity, discriminant validity and predictive validity (Garver and Mentzer, 1999). However, the most widely reported are convergent, discriminant, nomological and face validity which Hair *et al.* (2010) have considered to be the components of construct validity. These components were then applied in this thesis to assess the measurement model.

Convergent validity refers to whether the measured items converge for a specified latent construct. The assessment of convergent validity can be examined through factor loadings, average variance extracted (AVE) and reliability (Hair *et al.*, 2010).

High factor loadings indicate high convergent validity. In this study, however, the cut-off value of 0.60 was used as a rule of thumb. AVE represents the total amount of variance in the indicators accounted for by the latent variable (Garver and Mentzer, 1999). An AVE of 0.50 or higher indicates evidence of adequate convergence with AVE, less than 0.50 suggests more measurement error than the variance captured by the construct (Fornell and Larcker, 1981; Garver and Mentzer, 1999; Hair *et al.*, 2010). Another way of assessing the convergent validity is through reliability, which addresses whether consistent results will be produced across repetitive measurements (Carmines and Zeller, 1979). There are various ways of assessing reliability and the question regarding which method to apply is debatable. However, composite reliability is widely used along with the structural equation modelling (SEM) models. Thus, for this empirical work, composite reliability, which measures the squared sum of factor loadings for each construct and the sum of the error variance terms for a construct, was used. A reliability of 0.70 or higher suggests good reliability with values between 0.60 to 0.70 deemed acceptable (Fornell and Larcker, 1981; Hair *et al.*, 2010).

Discriminant validity examines if two latent constructs are distinct (Hair *et al.*, 2010). It can be assessed in two ways. However, the more commonly used is to compare the squared correlation of two latent variables with the AVE estimates, which was adopted in this research. Discriminant validity is achieved if the square root of AVE for a construct is higher than its correlation with the other constructs. This result suggests that the construct is distinct (Fornell and Larcker, 1981; Garver and Mentzer, 1999; Hair *et al.*, 2010).

The next type of validity is content validity, also known as face validity (Hair *et al.*, 2010). In this thesis, the term content validity is used, which is the extent to which measured items reflect the domain of content. The measure of content validity is rather subjective, but extensive knowledge of the constructs is required (Garver and Mentzer, 1999). This is aligned with another study, in which no measure has been agreed on as to whether content validity has been attained (Carmines and Zeller, 1979). Content validity can be established in various ways. Previous studies have used literature review, pretest, Q-sort and pre-established scales to establish content validity (Yang *et al.*, 2004; Li *et al.*, 2005; Furlan, Vinelli and Dal Pont, 2011; Zhao *et al.*, 2011).

Once the reliability and validity of the measurement model had been satisfied, a structural model was estimated. Path analysis, which is the simpler version of SEM, was applied to test the proposed relationships. In testing the structural model, two issues were examined: firstly, the model fit was used, to decide whether to accept the proposed model, and secondly, the structural parameter estimates (Hair *et al.*, 2010). In specifying the structural model, HIC, TIC, MIC and CIC constructs were selected as the factors that influence the firm performance of a firm. However, these relationships were mediated by the participation of SMEs in HVM SCs.

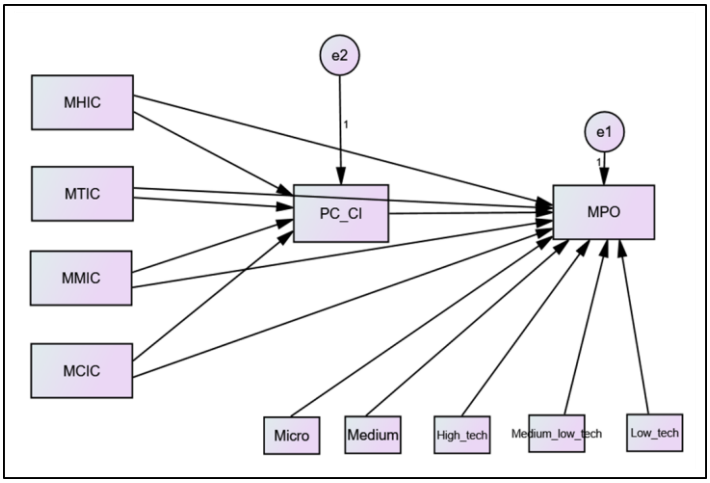


Figure 3-7: Path Diagram (source: The author)

Based on this, a path diagram, as drawn in Figure 3-7 and nine hypotheses were built as discussed earlier in Chapter 2. Using the path analysis, model fit and path estimates were identified. The same model fit indices as the measurement model were used. They were TLI, CFI, RMSEA and normed χ^2, in addition to χ^2 and degree of freedom. The path estimates determined whether the hypotheses were to be accepted or rejected.

3.6 Phase 3 – Qualitative research: Case studies

Following on from the questionnaire survey, case studies were used to validate the quantitative data. Case studies enabled an in-depth investigation of the companies to be carried out. In OM, it is common for researchers to combine the use of survey and case study to improve the research rigour of the empirical work (Choi *et al.*, 2016).

3.6.1 Case study design

As indicated in Section 3.3.2, case research can be either single- or multiple-cases. Yin (2018) has categorised case study into four types of designs. The first two involve a single-case, also known as Type 1 – holistic single-case, and Type 2 – embedded single-case studies. In an embedded single-case study, more than one level of unit analysis may be involved. This happens when the investigation focuses on a subunit(s). The other two types are called Type 3 – holistic multiple-case and Type 4 – embedded multiple-cases. These two types contain more than a single-case. In the same way as the single-case study, multiple-case design can either be holistic or consist of multiple subunits.

In deciding whether to use single- or multiple-case designs, Yin (2018) has claimed that multiple-case designs are more preferred than the single-case if one has the choice and resources. Yin provides five rationales of using single-case studies: a) a critical case to test the theory or theoretical propositions, b) unusual settings, c) a common case, d) revelatory, and e) longitudinal case. Within the single-case study, the researcher only investigates within each setting and one critical/rare/common case. Moreover, Voss *et al.* (2002) highlighted that single-case study is often apply in longitudinal research. Multiple-case study, on the other hand, allows the researcher to analyse similarities and differences between cases (Baxter and Jack, 2008).

In this research, holistic multiple-case studies were employed as the research was interested in the similarities and differences within and between the cases. This is supported by Yin (2018), i.e. that there is a chance of doing a good study through multiple-cases rather than single-cases, even just a “two-case”. Furthermore, several researches have been conducted on interaction capabilities employing multiple-case studies. Within a survey of multiple SMEs, polar type was used to select one case of high participation and one case of low participation. Polar type increases the understanding of why a high participation firm acts the way it does, while low participation firms act in a different way (Meredith, 1998). In deciding whether the firms fell into high or low participation, a quartile was used to find the median, the middle value of the participation score. In this study, the median score

was 45. Therefore, a score below 45 was considered as low participation, while a score above 45 was considered as high participation.

3.6.2 Instrument and protocols

A case study protocol should include four sections: a) an overview of the case study, b) field procedures, c) case study questions, and d) a reporting protocol (Rowley, 2002; Yin, 2018). In all the sections, Section C is the core of the case study protocol as it contains a set of substantive questions (Voss *et al.*, 2002; Yin, 2018).

In this research, the overview of the case study was covered in the participant information leaflet (PIL) where the background of the study was presented. The PIL provided information to the participants regarding the purpose of the study, benefits and disadvantages of participating, the people involved in the case study project and some information on ethical issues. The PIL is attached in Appendix F.

The second section, field procedures, includes elements related to gaining access to the organisations and participants, resources to use while conducting the case study and some procedures for protecting human subjects. Some of the field procedures were shared with the participants in the PIL. Participants were informed that the interview would take approximately two to three hours and be held at the company premises. The PIL was circulated to potential participants via email a minimum of 24 hours before the interview. Having identified the two companies, dates were arranged with the key informants. Two investigators were used to conduct the case study, with one investigator handling the interview questions while the other documented the contact notes. The use of multiple investigators provides richness and confidence to the data through complementary and conflicting insights of the team members (Eisenhardt, 1989).

Data collection involved two companies, with one high participation firm involved in injection moulding and the low participation firm involved in coatings. In each organisation, data were collected through semi-structured interviews. The interviewees were the Managing Director (MD) and Group Finance Director from the high participation company, and the Chief Executive Officer (CEO),

engineering manager and sales/administration manager from the low participation firm, who were all knowledgeable and had a significant role in the company. In total, five interviews were conducted. The semi-structured interview protocol was structured in two phases. The first phase covered the research context related to the company structure, organisational strategy, customer base and growth strategy, while the second phase was structured around the research content of interaction capabilities. The details are attached in Appendix G.

The interviews were audio-recorded and contact notes were taken which recorded the responses from the participants. In this study, data were analysed within-case which involved detailed write-ups for each company using verbatim interview extracts to ensure the transparency, reliability and validity of the data (Eisenhardt, 1989). Data are discussed in this thesis and potentially in conferences and future publications.

3.7 Ethical considerations

One of the important parts to be considered when doing research is ethical issues. Ethics implies a system, or expected moral principles, while conducting research (Sekaran 2003; Forza 2016). Ethical conduct involves the organisation and the associates that sponsor the research, the researchers who carry out the research, and the respondents who participate in providing the data. Since this study involved humans, ethical approval was sought from the Biomedical and Scientific Research Ethics Committee (BSREC) and the approval of REGO-2017-2033 AM01 was obtained from the committee. Informed consent was considered to be sought when respondents completed the questionnaire online. At the front of the questionnaire, an information leaflet was provided to respondents and covered several aspects, such as voluntary participation and withdrawal from participating, anonymity of respondents and for how long the data would be kept. Participation in this questionnaire was entirely voluntary. As such, respondents could withdraw at any time without giving a reason, by closing the web browser, but they could not withdraw once the data were submitted. In terms of anonymity, the questionnaires did not contain the respondents' names or their initials so as to ensure the confidentiality of the respondents.

On the other hand, for the case studies, a PIL was circulated to the participants via email a minimum of 24 hours ahead of the interview. A consent form was given to the participants on the day of the interview and participants would then sign the consent form to confirm that they would take part in the project. Interviews would only start once consent was received from the participants. The information provided by the participants would be pseudonymised and all data kept confidential.

The collected data are to be stored for ten years on a university computer and shared with the supervisors (Janet Godsell and Antonios Karatzas) and other researchers who plan to publish together in the future.

3.8 Summary

This chapter has covered two main parts in the research design. The first part of the chapter discussed the philosophical stand of the researcher, which was pragmatism. In the second part, the research approach was covered. The world view of pragmatism has shaped the approach to research into three phases of sequential mixed methods. The first phase described three main steps in developing interaction capabilities scale. The steps involved item generation, structured interview and Q-sort, and scale pretest. Prior to the distribution, the questionnaire was piloted with five academics and 41 respondents. The second phase followed by a large empirical work that was carried out with a sample of 181 respondents from SMEs in the HVM industry. From the obtained data, Anderson and Gerbing's (1988) two-step approach was adopted to test the measurements and structural models. The research design was followed by the case study approach. Within this, two companies, one from high participation and the other from low participation, were involved. The chapter ends with arguably the most important part in any research, ethical principles.

4 MODEL DEVELOPMENT

4.1 Introduction

This chapter outlines the model development by extending the conceptual framework developed in Chapter 2. The model uses the correlational design to describe and measure the relationships between two or more variables. This chapter establishes a set of hypotheses for the relationships between four interaction capabilities and participation and firm performance. Section 4.2.1 focuses on direct relationships between interaction capabilities and participation, and participation with firm performance, whereas Section 4.2.2 discusses participation as a mediator. Drawing from six hypotheses, a model is developed and presented in Section 4.3. Finally, in Section 4.4, a summary of the chapter is presented. The structure of the chapter is illustrated in Figure 4-1.

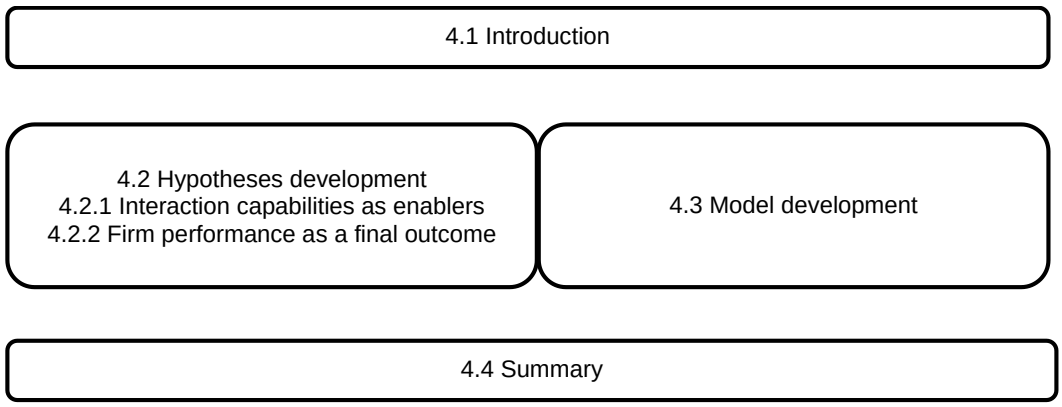


Figure 4-1: Structure of Chapter 4

4.2 Hypotheses development

4.2.1 Interaction capabilities as enablers

Researchers have long argued that knowledge is a key resource for a firm to achieve competitive advantage (Grant and Baden-Fuller, 1995; Grant, 1996b; Nonaka, 2007). Knowledge that is comprised of information, technology, know-how and skills can help SMEs to sustain competitive advantage. A study by Jean *et al.* (2018) has shown that supplier joint learning capability enhances innovation in GSCs. Jean and colleagues emphasised that joint learning capability can be seen

as a way to generate new knowledge through the exchange relationship promoting innovative outputs. Their study showed the effect of joint learning in driving both radical innovations, such as new product introduction (NPI), as well as incremental innovations, such as improvement in product quality, reliability and consistency. Learning and knowledge sharing are considered to be important constituents in inter-firm buyer-supplier relationships. In a work by Cheung *et al.* (2010), relationship learning, which is characterised as knowledge integration, plays a critical role in cross-border business exchanges between suppliers and buyers. The critical role played by relationship learning has given significant value to relationships of both buyers and suppliers. On the other hand, Johnsen and Ford (2006) highlighted that a combination of expertise across the network enables SMEs to develop unique offerings and new customer groups.

The role of learning and knowledge sharing is not only recognised in inter-firm relationships but also intra-firm relationships. It is evident that knowledge sharing within firms significantly influences innovation speed and quality (Wang and Wang, 2012). Similarly, Calantone *et al.* (2002) highlighted that learning orientation enables firms to innovate by introducing new products. In contrast, Barbero, Casillas and Feldman's (2011) work found that human capabilities impede SME's high growth in market expansion and innovation expansion. However, their results showed a significant effect on innovation expansion but to a lesser extent. Thus, this notions leads to the first hypothesis:

Hypothesis 1: Human interaction capability (HIC) is positively associated with participation.

Technological capability has been considered to be one of the strategic resources for firms to achieve competitive advantage. Previous studies have discussed the importance of technological capability in a dynamic environment. Teece (2014) in his study indicated how technological capabilities and the ability to use technology and intellectual property (IP) have enabled Texas Instruments to grow in a competitive global electronics industry. Similarly, McEvily, Eisenhardt and Prescott (2004) highlighted that more innovations, such as products and processes improvements, can be achieved through superior technological competencies. This is evident in the Ngugi *et al.* (2010) work which showed that TIC acquired by

SMEs enabled the firms to enhance product innovation through NPI, increase product ranges and succeed in launching new products. In line with this, another previous study emphasised that networks matter to innovation in SMEs. This is due to the nature of SMEs being a lack of resources and thus, collaboration with other firms would help them to innovate successfully (Gronum, Verreynne and Kastelle, 2012). A study by Johnsen and Tseng (2010) indicated that joint projects or training with customers have made suppliers aware of customers' requirements for technological improvements and innovations. The role of technological capabilities is not only recognised in product or process innovation but also in market expansion. Lin, Lee and Hung (2006) pointed out that two capabilities, i.e. technology and marketing capabilities, are important in facilitating firms to expand into international markets and thus lead to higher performance. Therefore, this thesis argues that TIC acquired by SMEs enables them to increase participation in larger customers' SCs through product development, market expansion and diversification in their businesses. Drawing from the literature, this study proposes the second hypothesis:

Hypothesis 2: Technological interaction capability (TIC) is positively associated with participation.

The third construct in interaction capability deals with the ability of an SME to plan and collaborate effectively with larger customers at a strategic level. Within the context of HVM, planning and collaboration with larger customers are vital to enable SMEs to respond to the market changes as well as to improve their competitive position. In order for collaboration to succeed, it is crucial for buyer and supplier to work together through joint decisions, joint planning and goal setting (Mohr and Spekman, 1994; Nyaga, Whipple and Lynch, 2010). This can be achieved through communication and personal contact by SMEs. A study by Johnsen and Tseng (2010) showed that communication has given more opportunities for SMEs to be actively involved in strategic decisions made by customers. The joint relationship effort between buyer and supplier can enhance the relationship through trust-building (Nyaga *et al.*, 2010). Previous research has shown the importance of business planning in influencing the growth of small firms. Nyaga and his colleagues found that a significant relationship was present in established firms versus the new, small firms. Prior information from previous

operations, existing routines and processes that are held by established small firms support the planning process, whereas for new firms prior information is missing (Brinckmann, Grichnik and Kapsa, 2010). In contrast, Song *et al.*(2011), found that strategic planning decreased the number of NPD projects. Song and colleagues argued that improvised planning activities are more conducive than formal ones. In addition, another study found that relationships between customer and supplier less significantly influenced the performance of SMEs in launching new products or improving product innovations (Terziovski, 2010). On the other hand, another work (Kim and Lee, 2010) showed that strategic collaboration has not directly influenced market and product developments; instead, it influenced the developments through SC responsiveness. This argument suggests the third hypothesis:

Hypothesis 3: Managerial systems interaction capability (MIC) is positively associated with participation.

The fourth construct deals with CIC. Mazet, Salle and Spencer (1995) pointed out that a firm's strategy to establish a position, or maintain its position, needs to be differentiated against three geographical levels: local, national and global. In addition, the nature of the investment required and the type of actors in the other firms, with whom the firms will be in contact in the future, will differ according to the geographical levels. This shows the importance of tolerating other actors' cultures. Organisational culture can be viewed as one of the most widespread concepts in the field of management and organisational theory (Ogbonna and Harris, 2000). A work by Ngugi *et al.* (2010) has shown that the ability of SMEs to learn and understand their customers' culture and values enabled the SMEs to produce new products and processes. This is consistent with a later study by Talay and Dean (2012) who state that learning and tolerance of customers' cultures and norms have given opportunities for small firms to find different customers in the same markets. Understanding customers' cultures and values can be challenging to some SMEs but it is critical as CIC enables SMEs to establish a new position in wider networks (Johnsen and Tseng, 2010).

Culture can be the biggest impediment to innovation. It is agreed by Cui and Hertz (2011) that CIC is the most critical element of interaction capability that drives firms

to proactively find new solutions and guides firms to innovate in the right direction. Though the literature has shown a positive relationship between culture and innovation, Terziovski (2010) in his work revealed that innovation culture had an insignificant impact on SME performance, which was measured by improved product innovations and success in launching new products. In Terziovski's work, innovative culture was characterised by encouraging SMEs to have informal meetings, interactions and knowledge sharing with customers, to take risks in experimenting with new ways of doing things and encouraging SMEs to monitor their performance.

Despite the rich literature on organisational culture, limited research is found on inter-firm organisation culture. This is concurred by Ivanova-Gongne (2015) who found that no emphasis has been put on cultural aspects from an interaction approach perspective, although some notions exist regarding cultural distance. This leads to the fourth hypothesis:

Hypothesis 4: Cultural interaction capability (CIC) is positively associated with participation.

4.2.2 Firm performance as a final outcome

In this context, participation can be defined as the extent of SMEs' participation in larger customers' SCs in terms of product, market and diversification. The literature on high growth SMEs suggests that firms use a combination of forms of growth. Such combinations include product development, broadness of markets, number of market segments and number of customers (McDougall and Robinson Jr., 1990; McDougall *et al.*, 1994; Barbero Navarro *et al.*, 2012). The work by Barbero Navarro *et al.* (2012) showed that most of the SME firms used more than one form of growth to achieve high performance or growth. In their study, the firms were grouped into four clusters based on the degree of domestic/international expansion and degree of product innovation/penetration strategies, such as acquisition of new clients and retention of clients. Similarly, McDougall and Robinson Jr. (1990) and McDougall *et al.* (1994) mentioned that new venture SMEs used mixed forms of strategies. The strategies encompassed a range of products, number of market

segments, number of customers and integration strategies. However, the extant literature provides mixed results in relation to firm performance.

Barringer and Greening (1998) claimed that geographical expansion by SMEs can be seen as a unique and challenging form of growth. This is consistent with previous literature, i.e. that SMEs failed in their expansion efforts from the original location to one or more additional locations. Further, this challenging issue can be expressed through firm performance. A study by McDougall *et al.* (1994) showed that broader markets combined with other forms of growth, i.e. wider range of products, more channels of distribution, more customers and segments, had no effect on ROS and sales growth in comparison with the narrow breadth strategies. Similarly, in their empirical study, Barbero Navarro *et al.* (2012) did not find support for the idea that international expansion could improve the sales growth of SME firms. This is parallel to a study by Mishina, Pollock and Porac (2004) who reported a negative relationship between market expansion and the rate of short-term sales growth. In addition, their study revealed that product expansion also provides slow short-term sales growth.

In contrast, a study by Zahra, Ireland and Hitt (2000) found that international expansion has a positive effect on firms' performance, quantified by return on equity (ROE) and sales growth. This is supported by Nath, Nachiappan and Ramanathan (2010) and Qian *et al.* (2010) who argued that international diversification and geographical diversification had a positive impact on firms' performance. In another study, Song *et al.* (2011) found a number of NPD projects had a significant effect on ROI and overall performance on profit, sales and ROI relative to the objective of the business unit. This is consistent with a study by Gronum *et al.* (2012) that indicated innovation breadth is measured through NPI and/or services, products/services improvement, operational processes, and organisational and/or managerial processes, to enhance firm performance on profit, productivity, sales and a range of product growth. Despite the mixed results of previous studies, this thesis argues that SMEs' participation in larger customers' SCs could lead to better firm performance. It is evident that firms who are involved in HVM are able to succeed in a number of ways. For instance, changes in the business processes of Cox and Plant Products Ltd and AK Industries Ltd enabled the companies to save cost in the future. A collaborative project by

GlaxoSmithKline PLC and the TSB has enabled the former to make a multi-million pound investment. Therefore, this has led this thesis to propose the fifth hypothesis:

Hypothesis 5: Participation is positively associated with firm performance.

As stated previously, participation is proposed as a mediator of the links between interaction capabilities and SME performance. Within this hypothesis, and aligned with Barbero Navarro *et al.'s* (2012) work, this thesis identified several forms of participation, including product development, market expansion and diversification. Insofar as participation enables firms to expand their market (Zahra *et al.*, 2000), it may function as a critical mediator link by transmitting the effects of interaction capabilities represented by HIC, TIC, MIC and CIC on firm performance. Additionally, participation facilitates SMEs to increase their product range and succeed in launching new products (Ngugi *et al.*, 2010). To the extent that participation is a key for SMEs to grow (Barbero Navarro *et al.*, 2012), and provides a medium to improve business performance, investigating the mediating role of participation in this study is justified. Hence, the sixth hypothesis is suggested:

Hypothesis 6a: Participation mediates the relationship between the interaction capability of HIC and firm performance.

Hypothesis 6b: Participation mediates the relationship between the interaction capability of TIC and firm performance.

Hypothesis 6c: Participation mediates the relationship between the interaction capability of MIC and firm performance.

Hypothesis 6d: Participation mediates the relationship between the interaction capability of CIC and firm performance.

4.3 Model development

In developing the model, as depicted in Figure 4-2, literature that is related to capabilities, buyer-supplier relationships, and customer-supplier relationships

within the dimensions of humans, knowledge, technology, managerial systems and culture has been used. This study argues that the literature in these areas is significant enough to complement the scant research on interaction capabilities. It is through interaction with larger customers that SMEs' capabilities in specific areas are more likely to achieve high growth. The growth, which was termed participation in this study, was based on the literature on new ventures, growth strategies and innovation. Literature on these areas was deemed relevant to capture the forms of increased participation due to scarce literature on the forms of growth (Barbero Navarro et al., 2012). Referring to previous literature, many different measures of growth have been used by researchers, including sales, sales growth, profitability, market share and ROE (Zahra *et al.*, 2000; Nath *et al.*, 2010; Gronum *et al.*, 2012). However, sales and sales growth have been used widely in most of the empirical growth research because it is applicable to all types of firms and insensitive to both capital intensity and the extent of integration (Delmar, Davidsson and Gartner, 2003). Although, this thesis did not use sales or sales growth, income growth that was comparable to sales growth was chosen. In addition, this thesis was interested in overall performance and thus, the six dimensions of firm performance were chosen which covered the growth and profitability aspects.

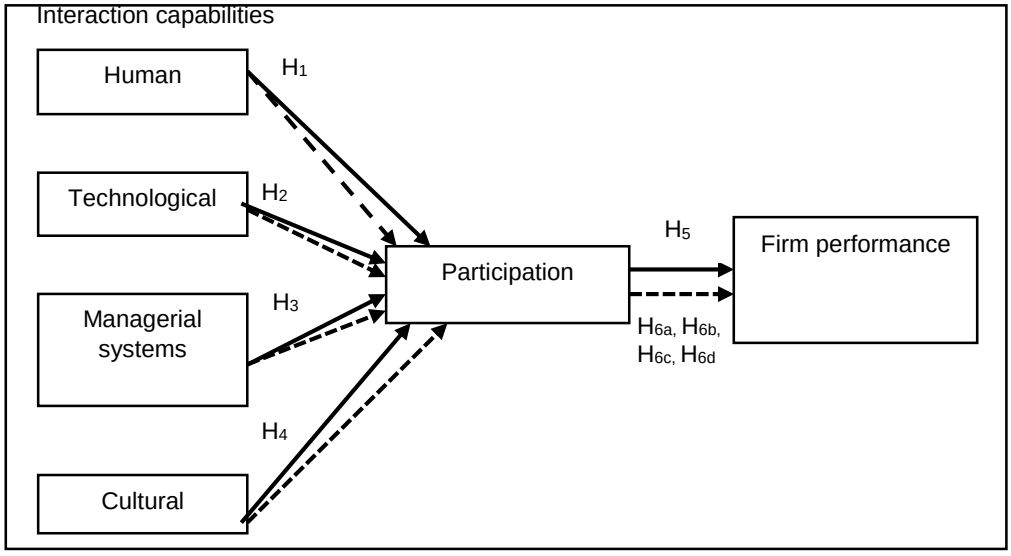


Figure 4-2: Model development of role of interaction capabilities to increase SME participation in larger customers' SCs

Since this study covers the interaction between SMEs and their larger customers, relationships models were examined. It was found that common key constructs are

present across different disciplines of relationships models. Within the OM literature, constructs such as trust, relationship commitment, information sharing, goal congruence, decision synchronisation, collaborative communication, and resource sharing have been used (Moore, 1998; Cannon *et al.*, 2010; Cao and Zhang, 2011, 2013). The same relationships' constructs have also been used in marketing. These constructs include information exchange, operational linkages, legal bonds, cooperative norms, adaptations by both buyers and suppliers, mutual cooperation, trust and satisfaction (Cannon and Perreault Jr., 1999; Lages, Lancastre and Lages, 2008). In addition, similar relationship constructs, encompassing flexibility, information exchange, shared problem solving, power, commitment, coordination and trust, have been seen in the management literature (Heide and Miner, 1992; Mohr and Spekman, 1994). Although researchers have used different definitions and measures for each construct, there is still a consensus on the key constructs in modelling long-term relationships (Wilson and Möller, 1995). In this thesis, however, relationship constructs were not used in developing the model of this study. This is because previous literature on relationship dimensions were more focused on dyadic constructs. That means that relationship constructs such as trust are measured in both relationships, i.e. buyer and supplier, whereas this study focused on SMEs' capabilities in HIC, TIC, MIC and CIC with reference to their relationships with larger customers.

4.4 Summary

This chapter has presented a model development that consisted of six hypotheses. Of the six hypotheses, four have linked interaction capabilities encompassing HIC, TIC, MIC and CIC to participation; the fifth relates to participation and firm performance, and the sixth has demonstrated a link between four interaction capabilities and firm performance through participation.

5 PHASE 1 – SCALE DEVELOPMENT RESULTS

5.1 Introduction

This chapter discusses the results of the pilot testing that was conducted with a sample of 41 companies. It has four sections, Sections 5.2 to 5.5 present results of the HIC, TIC, MIC and CIC constructs respectively. Factor analysis and reliability were run on individual constructs and the same procedures were used for all the constructs. A sample of 41 observations was deemed suitable based on the 5:1 ratio rule, as HIC, TIC and CIC constructs had fewer than eight items, but not for the MIC construct which had nine items. The rule was irrelevant in the case of the MIC construct because high communality and one factor were achieved for the construct. The summary of the chapter is provided in Section 5.6. The structure of the chapter is illustrated in Figure 5-1.

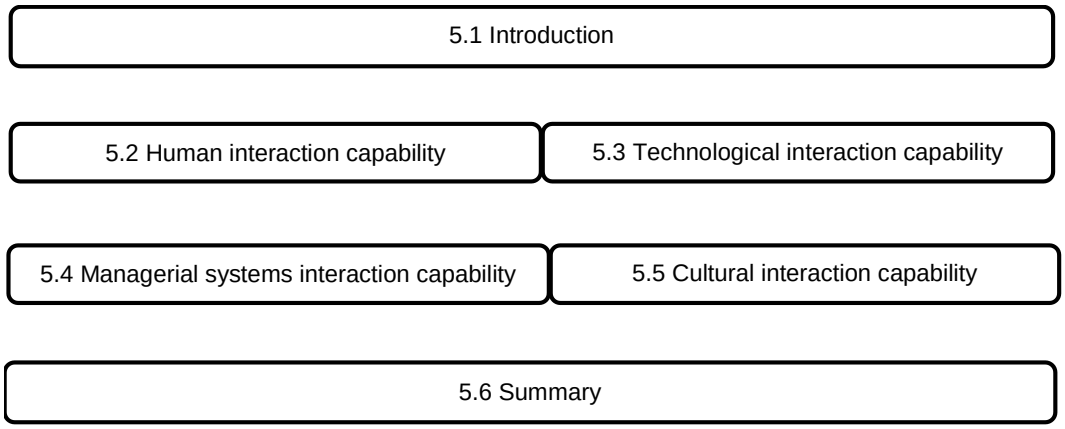


Figure 5-1: Structure of Chapter 5

5.2 Human interaction capability

By using the aforementioned criteria in Section 4.4.3, an overall Kaiser-Meyer-Olkin (KMO) for the HIC items that measured the sampling adequacy was achieved at 0.703, with all individual items greater than 0.629, which was above the bare minimum of 0.50. Bartlett's test χ^2 (15) = 104.187 $p < 0.001$ was highly significant, denoting suitability for factor analysis (Field, 2009). Based on Kaiser's criterion, one factor with eigenvalues over 1 was extracted, which explained the 48.49% of variance. Employing the minimum criteria of 0.50 for factor loading, one item

("*Combining knowledge with larger customers to develop new products"*) needed to be removed. After removing the item, the KMO statistic of 0.683 and Bartlett's test of sphericity ($p < 0.001$) were examined again and the results confirmed the sampling adequacy. In addition, the construct had high reliability, Cronbach's α = 0.851, even though it was the lowest α among the other three interaction capabilities constructs. However, it still exceeded the recommended threshold for the newly developed scale. Table 5-1 shows the final factor loading results for each of the HIC items.

Table 5-1: Factor loadings and α for HIC

	α=0.851	**Factor 1**
Developing internal skills and knowledge during joint projects with larger customers		0.630
Erroneously remained Combining knowledge with larger customers to develop new products		
Gaining knowledge from visits to larger customers		0.589
Forming cross-functional, cross-hierarchical teams with larger customers to facilitate knowledge exchange		0.738
Working with larger customers to build new or common areas of expertise		0.833
Erroneously dropped Combining our expertise with the expertise of larger customers		0.863

Note: Erroneously remained and dropped items occurred in the main empirical work

However, in the main empirical work, a different item *("Combining our expertise with the expertise of larger customers")* was erroneously dropped instead of ("*Combining knowledge with larger customers to develop new products"*). The mistake occurred due to the similar wording of the two items, which created confusion. This was only realised after the main empirical work had been completed. As a result, respondents were contacted to provide responses for these two items only. Due to the poor response and based on the feedback given by some of the respondents, the wrong item was left in the main empirical work. However, the wrong item was eventually dropped after CFA was conducted.

5.3 Technological interaction capability

For TIC, the KMO and Bartlett's tests confirmed that the items sufficiently met the minimum criteria of 0.50. However, Kaiser's criterion measure revealed that two factors with eigenvalues over 1 were extracted. As a single factor was expected for the TIC variable, two items were identified to load highly to a second factor, as tabulated in Table 5-2. Thus, these items (*"Upgrading our IT systems to adapt to*

those of larger customers" and *"Adapting our production lines to satisfy larger customers' requirements")* were removed from further analysis.

Table 5-2: Cross loadings items of TIC

	***α*=0.886**	**Factor 1**	**Factor 2**
Developing new ways to integrate our technological systems with those of larger customers		0.882	
Customising our technological systems to those of larger customers		0.880	0.312
Developing our systems/technology according to larger customers' wishes		0.798	
Developing new technology through joint R&D activities with larger customers		0.444	
Achieving technological innovation through larger customers		0.581	0.472
Upgrading our IT systems to adapt to those of larger customers			0.856
Adapting our technologies to new larger customers to provide customised service offerings		0.665	0.396
Adapting our production lines to satisfy larger customers' requirements			0.536

Table 5-3: Factors loadings and *α* for TIC

	***α*=0.899**	**Factor 1**
Developing new ways to integrate our technological systems with those of larger customers		0.854
Customising our technological systems to those of larger customers		0.932
Developing our systems/technology according to larger customers' wishes		0.843
Developing new technology through joint R&D activities with larger customers		0.525
Achieving technological innovation through larger customers		0.723
Removed Upgrading our IT systems to adapt to those of larger customers		
Adapting our technologies to new larger customers to provide customised service offerings		0.774
Removed Adapting our production lines to satisfy larger customers' requirements		

Improved factor loadings of the TIC construct were obtained after removing the two items, as presented in Table 5-3. KMO statistics = 0.832 and Bartlett's test χ^2 (15) = 159.111, $p < 0.001$ were obtained, to confirm the sampling adequacy for the factor analysis after dropping the two items. Kaiser's criterion was used to extract one factor that accounted for 61.79% of the variance. Aside from this, Cronbach's *α* of 0.899 confirmed the TIC construct to be reliable.

5.4 Managerial systems interaction capability

The same procedure was used to determine the structure of the MIC construct. Overall KMO statistics of 0.857 and individual item KMO was greater than 0.813 proving its adequacy to run factor analysis. Bartlett's test of χ^2 (36) = 333.923, $p <$

0.001 was obtained to confirm the sampling adequacy for the factor analysis. Adopting Kaiser's criterion, one factor was extracted, which explained 65% of the variance.

Table 5-4: Factor loadings and *α* for MIC

	***α*=0.941**	**Factor 1**
Planning jointly with large customers		0.855
Developing business plans in collaboration with larger customers		0.766
Solving joint problems with larger customers		0.800
Including larger customers in our goal-setting activities		0.703
Aligning our strategy with the strategy of larger customers		0.808
Understanding larger customers' strategic plans		0.791
Incorporating larger customers' requirements into our plans, policies and objectives		0.911
Assisting larger customers in their planning activities		0.732
Responding to larger customers' planning activities		0.870

Table 5-4 presents the factor loading of each item after rotation was made, with reliability shown to be the highest among other constructs. Cronbach's α = 0.941 indicates good reliability. Although the rule of ratio 5:1 was not satisfied, the results showed high communality with all the items converged into one factor. As such, the ratio of 5:1 was irrelevant in this case.

5.5 Cultural interaction capability

Repeating the same procedure, six items of the CIC construct were examined. KMO was calculated and achieved for individual (> 0.822) and multiple (0.854) variables. Bartlett's measure of χ^2 (15) = 131.747, p < 0.001 denoted that the correlation matrix was not an identity matrix and that there were some relationships between variables.

Table 5-5: Factor loadings and *α* for CICs

	***α*=0.881**	**Factor 1**
Tolerating the culture of larger customers		0.658
Developing common working culture and values with larger customers		0.876
Adapting to larger customers' values and culture		0.901
Treating larger customers as friends irrespective of their culture		0.818
Changing our culture and values when a larger customer requires it		0.519
Integrating our culture and values with those of larger customers		0.707

The CIC analysis construct produced a single factor that explained 57.53% of the total variance. Factor loading of each item was greater than the minimum threshold of 0.50 as shown in Table 5-5.

5.6 Summary

This chapter has focused on the results of the pilot study. The scale was validated using EFA and Cronbach's α. With regard to factor analysis, the KMO measure confirmed that the sampling adequacy for all the constructs was above the acceptable threshold of 0.50 (Field, 2009). Bartlett's test of sphericity indicated that correlation matrices were not identity matrices and there were relationships between the items of each construct. All the four latent variables produced a single factor that explained total variance ranges from 48.9% to 65%. In addition to factor analysis, Cronbach's αs range from 0.851 to 0.941, indicating the good reliability of the scale. The good results of these two measures confirmed the readiness of the scale to be used in the large-scale data collection. In summary, a total of 26 items were retained for the next stage of data collection as their loadings were greater than 0.50.

6 PHASE 2 – QUANTITATIVE RESEARCH: SURVEY ANALYSES AND RESULTS

6.1 Introduction

This chapter describes how the survey data is analysed. The chapter begins with descriptive statistics in Section 6.2. Descriptive analyses of 181 respondents are provided for interaction capabilities, participation, firm performance and HVM. The analyses included the means, standard deviations, skewness and kurtosis. Data were then analysed in a two-step approach. The first step involved the measurement model, as discussed in Section 6.3. In this section, a CFA was estimated to analyse the fit of HIC, TIC, MIC, CIC and firm performance. In the second step, the structural model was analysed using a path analysis (Section 6.4). From the structural model analysis, the results provide insight guidelines as to which interaction capabilities are significant in helping SMEs to increase participation and perform better in larger customers' SCs (Section 6.4). By employing rigorous scale development procedures, a psychometrically sound and parsimonious interaction capability scale is finalised in Section 6.5. The development of the interaction capabilities scale allows further large empirical work to be conducted. Finally, Section 6.6 concludes the main findings of survey. The structure of the chapter is illustrated in Figure 6-1.

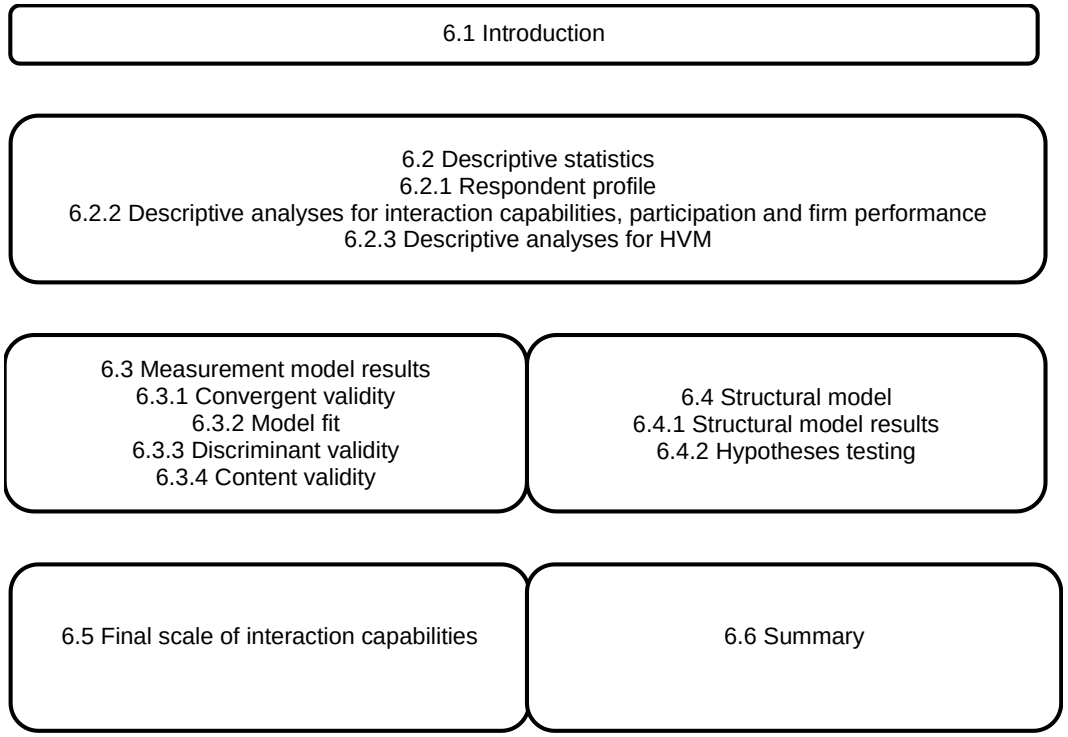


Figure 6-1: Structure of Chapter 6

6.2 Descriptive statistics

This section provides information about the UK manufacturing companies, taken from a survey that was conducted in 2017. It consists of three sub-sections that present the demographic profile of the respondents, as well as the descriptive statistics of interaction capabilities, participation, firm performance and HVM (Sections 6.2.1, 6.2.2 and 6.2.3 respectively). Section 6.2.1 explores the characteristics of the respondents, which can be broken down into the number of employees, industry, annual turnover, legal structure, level of management, number of years working, and geographical markets. In addition, it provides an analysis of the interaction capabilities, the participation and the firm performance.

6.2.1 Respondent profile

There were 181 UK manufacturing companies that participated in the survey. Table 6-1 shows the diversity of the respondents in terms of number of employees in the company, industry, annual turnover, legal structure and the age of the company.

Table 6-1: Demographic background of respondents

No of employees	**Number**	**Percentage**
1-9	43	23.8
10-50	85	47.0
51-250	53	29.3
Industry	**Number**	**Percentage**
Electronics	22	12.2
Industrial and mechanical equipment	25	13.8
Automotive	18	9.9
Capital projects and infrastructure	1	0.6
Rubber and plastics	14	7.7
Electrical equipment	8	4.4
Biomedical equipment	1	0.6
Energy, utilities and mining	2	1.1
Food and beverages	13	7.2
Chemicals	11	6.1
Aerospace, defence and security	11	6.1
Health and beauty care	2	1.1
Basic metals	4	2.2
Engineering and construction	10	5.5
Pharmaceuticals	3	1.7
Forest, paper and packaging	1	0.6
Others	35	19.3
Annual turnover	**Number**	**Percentage**
< £2 million	75	41.4
£2 million - £10 million	79	43.6
£10 million - £50 million	26	14.4
£50 million - £100 million	1	0.6
Legal structure	**Number**	**Percentage**
Ordinary business partnership	1	0.6
Limited partnership	3	1.7
Limited liability partnership	1	0.6
Limited company	176	97.2
Age of company	**Number**	**Percentage**
0 – 5	9	5
6 – 10	20	11
11 – 20	37	20.4
Over 20	115	63.5
Job function	**Number**	**Percentage**
Accounting/Finance	8	4.4
General management/Human resources	53	29.3
Marketing/Sales	20	11.0
Production/Manufacturing	18	9.9
Planning	1	0.6
Purchasing/Procurement	2	1.1
Research and Development	6	3.3
Supply chain	3	1.7
Other	70	38.7

The final sample was represented by a plethora of industries including “electronics” (12.2%), “industrial and mechanical equipment” (13.8%), “automotive” (9.9%), “rubber and plastics” (7.7%), “food and beverages” (7.2%), “chemicals” (6.1%), “aerospace, defence and security” (6.1%), “engineering and construction” (5.5%), “electrical equipment” (4.4%), “pharmaceuticals” (1.7%), “energy, utilities and mining”, as well as “health and beauty care” (1.1%). “Capital projects and infrastructure”, “biomedical equipment” and “forest, paper and packaging” are each represented by 0.6%. Under the “others” category, there was a representation from “waste management”, “instrumentation” and other sectors (19.3%). Out of these, 47% were “small” companies with 10 – 50 employees, 29.3% were “medium” companies (51 – 250) and 23.8% had fewer than 10 employees. For turnover, 85% had a turnover of less than £10million (approximately €11.5 million), 14.4% with turnover between £10million (approximately €11.5 million) and £50million (approximately €57.9 million); and one company (0.6%) had a turnover above £50million (approximately €57.9 million), as illustrated in Figure 6-2. Of this, 99.4% had a turnover that met the criterion of SME annual turnover highlighted in Table 3-15.

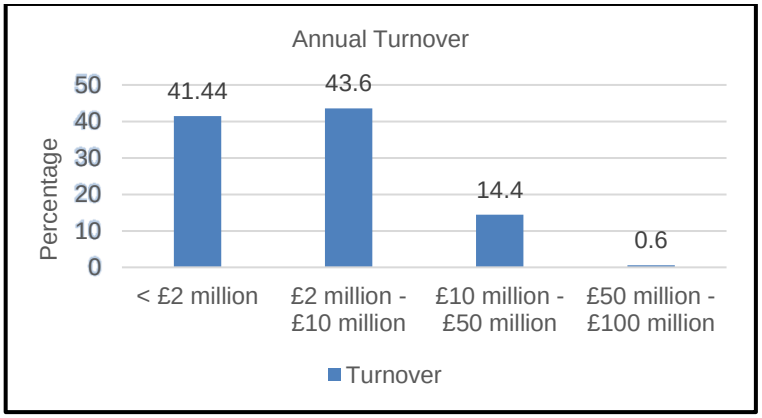


Figure 6-2: Annual turnover

As shown in Table 6-1, there are four legal forms of businesses: ordinary business partnership, limited partnership, limited liability partnership and limited company. Out of these, the majority of the respondents (97.2%) were “limited companies”, followed by 1.7% that were “limited partnerships”; “ordinary business partnerships” and “limited liability partnership” were at 0.6% each. Most of the micro and medium businesses were more likely to be limited companies. In addition, small businesses were more likely to have alternative legal forms, such as being in an ordinary

business partnership, or limited partnership, rather than just being limited companies (Figure 6-3). Limited company was the preferred legal status of the majority of the firms, possibly due to its major advantage, which separates the owner's assets and finances from those of the business. This means that the owner's responsibility is limited to the amount he/she invested without risking their personal wealth. As shown in Table 6-1, the bigger proportion was businesses aged 21 years and more (63.5%), with 20.44% of the companies aged between 11 to 20 years, and approximately 16.02% of businesses aged less than 10 years.

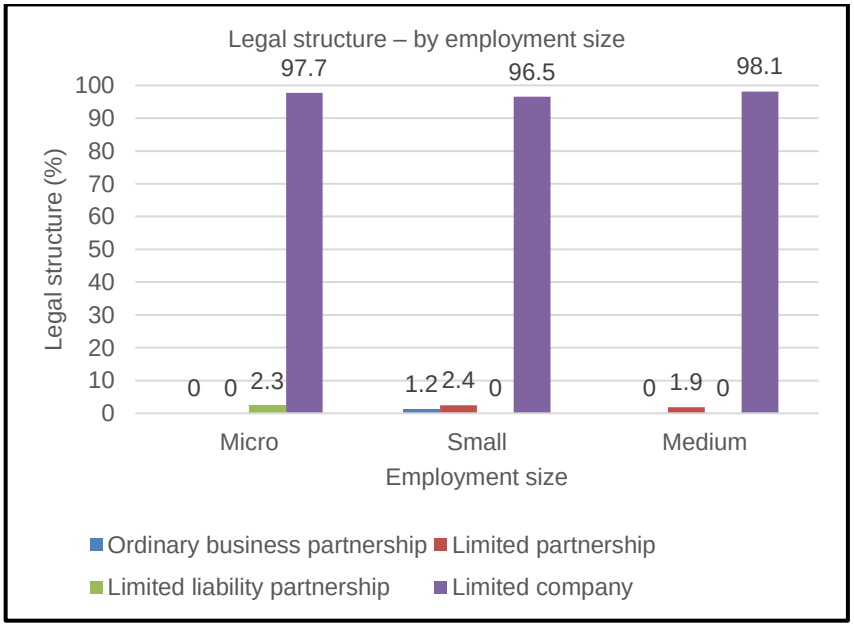


Figure 6-3: Legal structure - by employment size

As tabulated in Table 6-2, the majority of the respondents (89%) reported that they had not only served the local region, but had expanded their businesses to the entirety of the UK, with over half of those surveyed having expanded into Europe and beyond. Of the 181 respondents, only 24.9% operated solely in local markets.

Table 6-2: Current geographical markets

		Responses	
		N	Percent of cases
Current geographical markets	Local region	45	24.9
	United Kingdom	161	89.0
	Europe	102	56.4
	Rest of the world	92	50.8

As illustrated in Table 6-3, all the companies had engaged in various types of value chain activities. The majority of them (approximately 82.9%) were engaged in

"production", followed by 69.6% which were involved in the "design of the development of products and services", and 59.7% engaged in "sales and marketing". The other value chain activities such as "research" (36.5%), "logistics and distribution" (32.6%), and "after sales services" (39.8%) were less popular.

Table 6-3: Value chain activities

		Responses	
		N	Percent of cases
Value chain activities	Research	66	36.5
	Design of development of products and services	126	69.6
	Production	150	82.9
	Logistics and distribution	59	32.6
	Sales and marketing	108	59.7
	After sales services	72	39.8

As illustrated in Figure 6-4, the majority of the respondents (95%) held executive or senior management positions, but were also the owners of the companies.

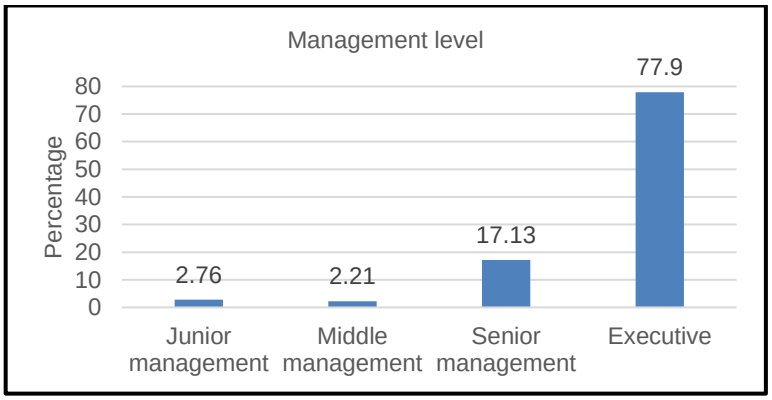


Figure 6-4: Management level

The greatest proportion of the respondents (77.9%) had been in executive roles for a period of more than 11 years, whereas those in senior management roles were almost equally distributed in terms of number of years of experience, ranging from less than a year to up to 20 years. In addition, 70.8% of the respondents were from micro and small companies who can be assumed to be fully knowledgeable about their company and thus act as single key informants.

6.2.2 Descriptive analyses for interaction capabilities, participation and firm performance

Table 6-4 presents descriptive analyses for eight variables. Following many other scholars, a mean score was used for Likert scale questions in the descriptive statistics. A mean score has been widely used in high impact journals in OM such as the Journal of Operations Management (JOM) and Production and Operations Management (POM) (Thirumalai and Sinha, 2005; Khazanchi, Lewis and Boyer, 2007; Delmas, 2010; Rashed, Azeem and Halim, 2013), operations research journals such as Decision Sciences (Sabherwal and Becerra-Fernandez, 2003) as well as marketing journals such as the Journal of Marketing Research (Cannon and Perreault Jr.,1999). For example, in the Decision Sciences journal, Sabherwal and Becerra-Fernandez (2003) used mean scores to explain which knowledge management processes influenced knowledge management effectiveness at individual, group and organisational levels. Using mean scores is justified when the sample size does not permit the use of more advanced methods. In this research for example, a full SEM approach would not have been appropriate, whereby the items would be properly weighted within the model, rather than assumed to be equally important in capturing the latent factor (as is the case when taking the mean of a scale).

Based on those analyses, CIC scores had a mean of 4.52 (out of seven), showing that SMEs were moderately effective in learning and tolerating the culture and values of their larger customers. The HIC mean (4.31) shows the average ability of SMEs in developing, combining and exchanging knowledge, skills and expertise with their larger customers. The MIC's mean was 4.28, capturing the ability of SMEs to plan and collaborate effectively with larger customers at a strategic level in comparison to their competitors. However, SMEs were slightly less effective in the technological interaction when compared to other capabilities (mean = 4.01).

In addition, the standard deviation for all interaction capabilities was rather small and comparable. The values of skewness were close to zero, indicating that the data were symmetrically distributed and the skew values for interaction capabilities, HIC, MIC and CIC, were negative, which indicated a build-up towards high scores as shown in Figure 6-5, 6-7 to 6-8. However, a bimodal distribution

was seen for TIC, as shown in Figure 6-6. Two peaks appeared; the one contributed by less technologically-intensive sectors concentrated around a score of two, whereas the one contributed by advanced technology sectors concentrated around a score of 5.5. This is due to the sample of this study, since the HVM industry does not require high technology intensity. For example, the food and drink sector does not require high technology, but can bring relative growth to the economy. On the other hand, the kurtosis values for HIC, TIC, MIC, were less than three and negative, indicating a flat and light-tailed distribution, whereas CIC has a pointed and heavy-tailed distribution in the diagram as the value of the kurtosis was 0.081 but still not normally distributed.

Table 6-4: Descriptive analyses for interaction capabilities, participation and firm performance

	HIC	TIC	MIC	CIC	Current participation	Future participation	Expected degree of change in participation	Firm performance
N	181	181	181	181	181	181	181	181
Mean	4.31	4.02	4.28	4.52	4.06	4.50	3.00	4.27
Median	4.40	4.17	4.33	4.83	4.10	4.55	3.10	4.17
Std. deviation	1.58	1.80	1.43	1.50	0.89	0.95	1.25	1.03
Skewness	-0.41	-0.38	-0.45	-0.69	-0.17	-0.24	-0.36	-0.05
Kurtosis	-0.52	-0.77	-0.14	0.08	-0.16	-0.43	-0.27	-0.00

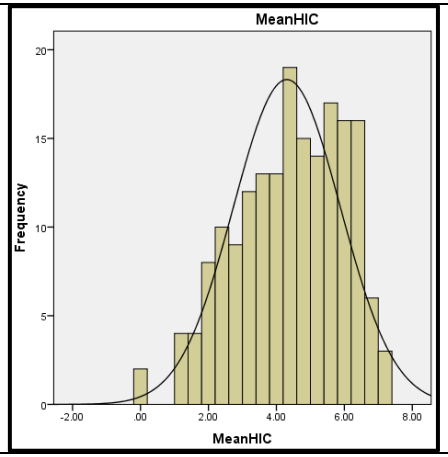


Figure 6-5: HIC histogram

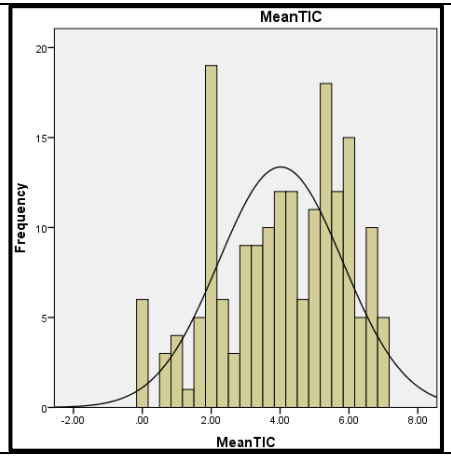


Figure 6-6: TIC histogram

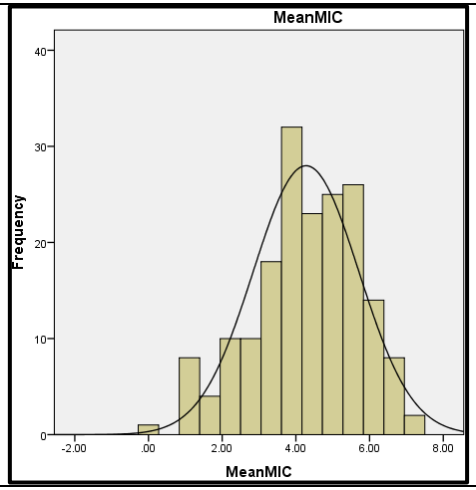


Figure 6-7: MIC histogram

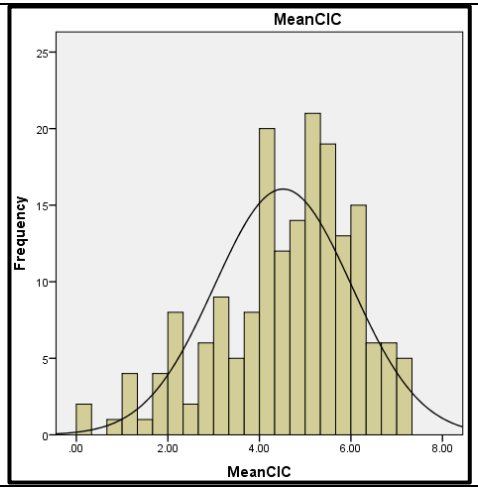


Figure 6-8: CIC histogram

For the participation construct, companies scored 4.06 (out of seven) on average, while putting the emphasis on establishing a “current competitive position” but would put more emphasis on the “future competitive position” (4.5). However, companies expected a slight decrease in the “change of participation”. The skew values for current emphasis of participation, future emphasis of participation and the degree of change in indicating participation emphasis, were close to zero and negative, which indicates data were symmetrically distributed and a build-up towards high scores. However, all the participation (current, future and expected degree of change) kurtosis values were negative, indicating a flat and light-tailed distribution of data, as shown in Figures 6-9 to 6-11. In addition, standard deviation for current participation and future participation was rather smaller than the value of “expected degree of change in participation”, showing a heavy-tailed distribution.

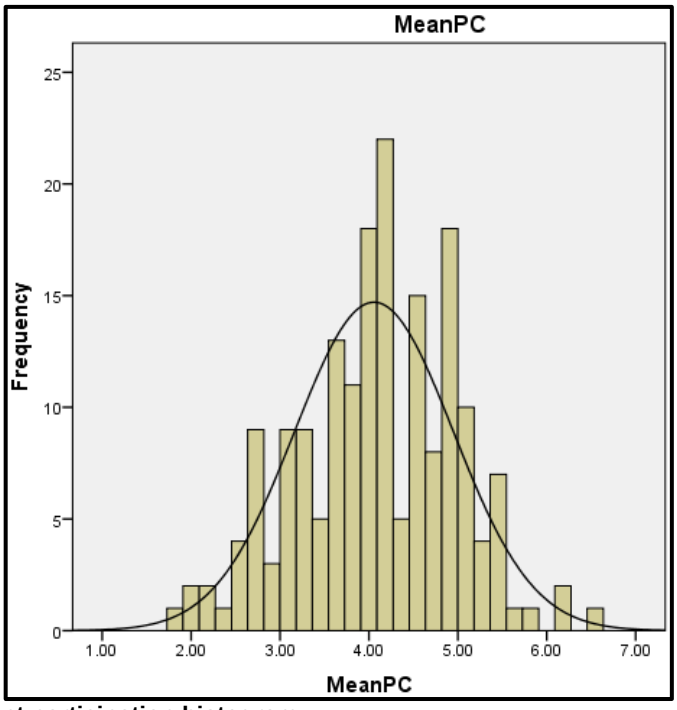


Figure 6-9: Current participation histogram

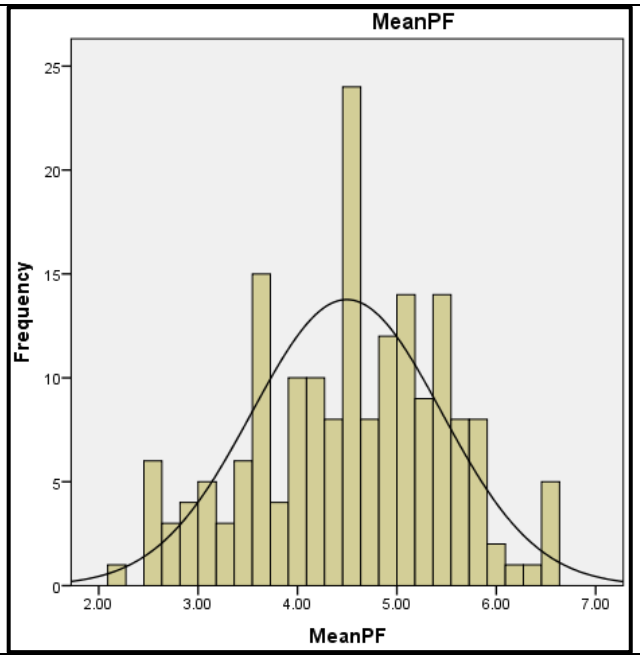


Figure 6-10: Future participation histogram

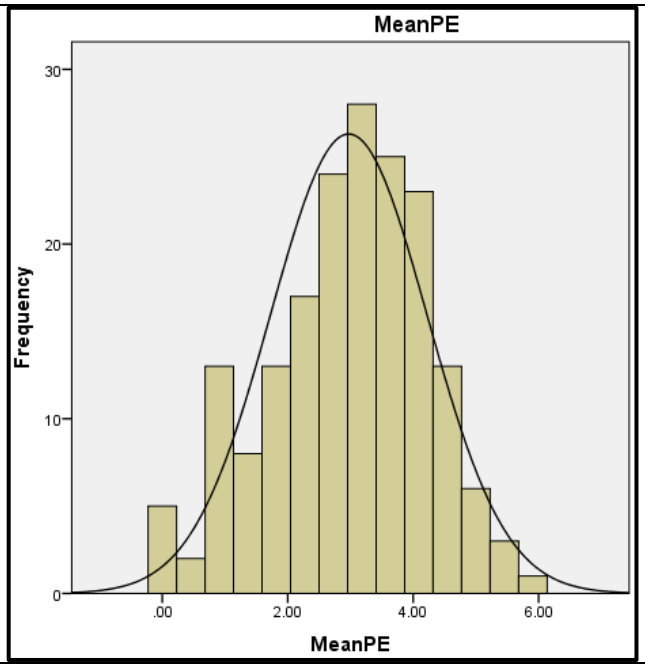


Figure 6-11: Expected degree of change for participation histogram

For firm performance, companies scored on average 4.27 (out of seven), indicating that these SMEs performed towards “best industry” when compared to their competitors. Figure 6-12 shows the histogram for firm performance. The value of skewness was close to zero and negative, showing the data were more likely to be symmetrically distributed and a build-up towards high scores. The negative value of kurtosis, presents a flat and light-tailed distribution.

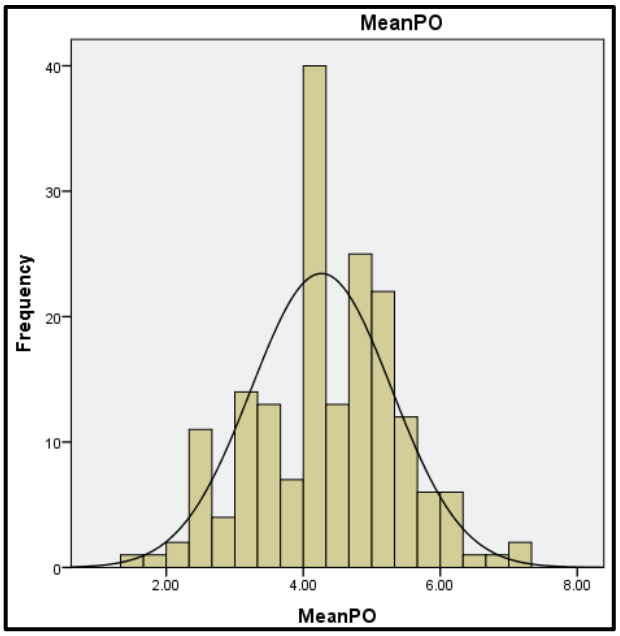


Figure 6-12: Firm performance histogram

6.2.3 Descriptive analyses for HVM

Table 6-5 shows the descriptive analyses for the HVM definitions. From all the definitions, more than half of the respondents agreed that HVM could be defined as “businesses with highly skilled employees” or with a “high level of investment”, less than 5% of them disagreed with that definition, with 13.26% being uncertain about it. For “application of new processes and technologies”, the proportion of the agreeing respondents was close to those who ranked the basis of competition as “highly skilled employees or high level of investment”. 23.76% of responses neither agreed nor disagreed that “HVM involves traditional, new and emerging industries”.

Table 6-5: HVM definitions results

	Application of new processes and technologies		Involvement in traditional, new and emerging industries		Highly skilled employees or high level of investment	
	Frequency	%	Frequency	%	Frequency	%
Do not know	6	3.3	6	3.3	5	2.8
Strongly disagree	1	0.6	1	0.6	2	1.1
Disagree	1	0.6	3	1.7	2	1.1
Somewhat disagree	5	2.8	7	3.9	4	2.2
Neither agree nor disagree	30	16.6	43	23.8	24	13.3
Somewhat agree	34	18.8	34	18.8	34	18.8
Agree	62	34.3	66	36.5	63	34.8
Strongly agree	42	23.2	21	11.6	47	26

On average, respondents ranked responsiveness at 2.78 out of four, flexibility at 2.67, followed by cost at 2.40 and quality at 2.15 as the basis of competition. It was quite surprising that respondents prioritised cost over quality as this contradicts a study conducted in Scotland, showing that Scottish manufacturing SMEs valued quality and customer service more than cost (MacBryde *et al.*, 2009). Moreover, it can be seen that the proportion of cost between the least liked and most liked basis of competition, was quite close at 39.78% and 32.60% respectively, as shown in Table 6-6. This shows that some of the respondents were still focused on cost, whereas others claimed that cost was no longer the primary basis of competition. On the other hand, the figures show that quality was not the basis of competition for 67.95% of the respondents. This was not a surprise, as UK SMEs ranked slightly higher in flexibility and responsiveness as a basis of competition, rather than cost and quality.

Table 6-6: Basis of competition results

	Cost		Quality		Flexibility		Responsiveness	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
1	72	39.8	61	33.7	24	13.3	24	13.3
2	24	13.3	62	34.3	49	27.1	49	27.1
3	26	14.4	28	15.5	50	27.6	50	27.6
4	59	32.6	30	16.6	58	32	58	32

Note: 1 (least liked), 4(most liked)

6.3 Measurement model results

Through the EFA in the pilot study, a measurement model was proposed. The measurement model included HIC, TIC, MIC, CIC and firm performance constructs, and was assessed through CFA, by examining validity and reliability. Participation construct was not included, as it was a formative construct. This means the participation construct was formed as a combination of “products”, “markets” and “diversification”; if any of these three measures increases, the participation would be increased as well. In contrast, if SMEs’ participation increases, other measures do not necessarily increase, unlike reflective measures where the measurement items reflect the latent constructs that they present (Johnston *et al.*, 2004). Within the CFA, model fit indices were used to measure the good fit of the model.

6.3.1 Convergent validity

Convergent validity denotes how well the item measures relate to each other with respect to a common concept, and is exhibited by having significant factor loadings of measures on hypothesised constructs (Anderson and Gerbing, 1988). In this study, convergent validity was established through factor loadings, AVE, and reliability. Factor loadings were examined for each of the constructs, as shown in Figures 6-13 to 6-16. Hair *et al.* (2010) stated that standardised loading estimates should be greater than 0.50, or ideally, should be 0.70. In this study, however, not many items had standardised loading estimates higher than 0.70. Thus, the middle loading estimate of 0.60 was used to identify the candidates for deletion. Figure 6-13 shows the factor loadings for the HIC construct.

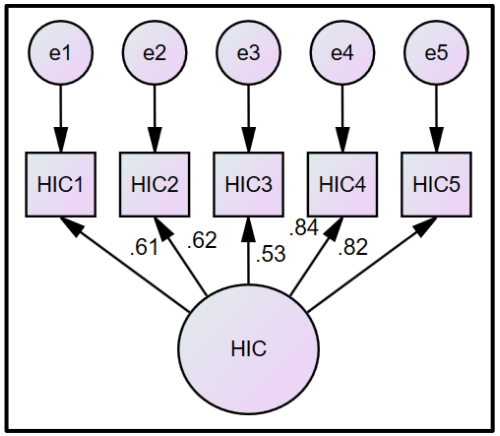


Figure 6-13: Factor loadings for the HIC

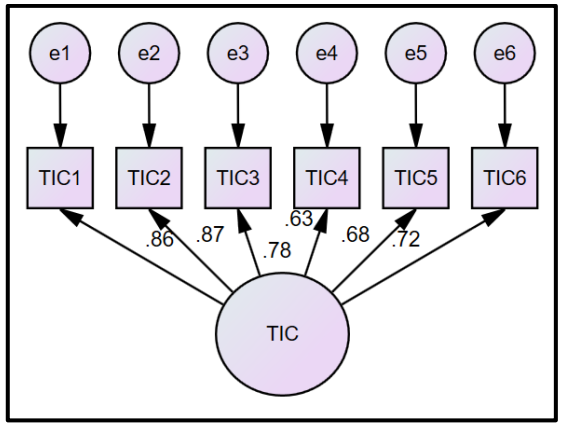


Figure 6-14: Factor loadings for the TIC

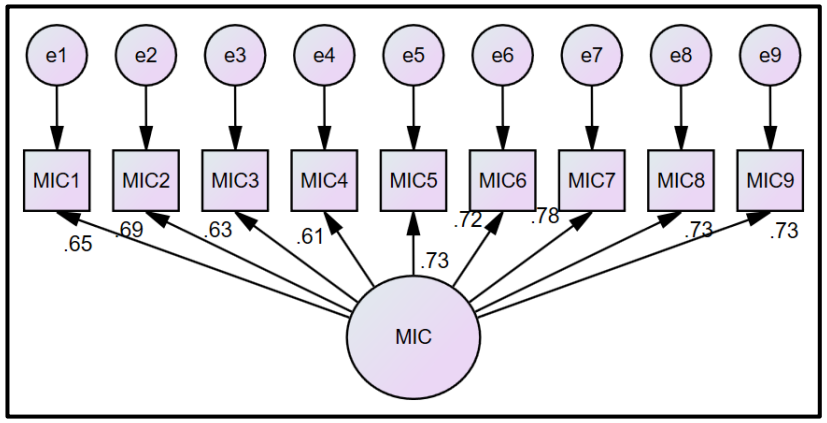


Figure 6-15: Factor loadings for the MIC

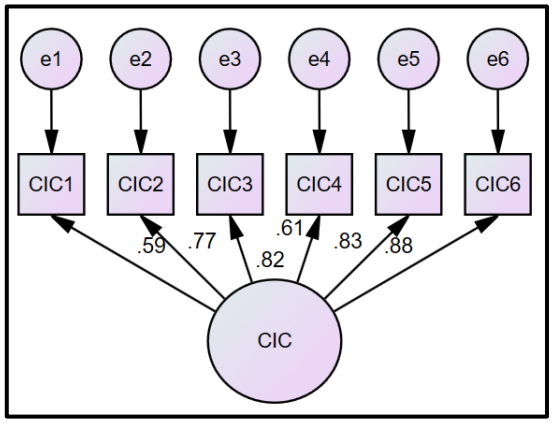


Figure 6-16: Factor loadings for the CIC

One item (HIC3) was removed, as it had a standardised loading below 0.60. The item was *("Gaining knowledge from visits to larger customers")*. Factor loadings for the TIC are illustrated in Figure 6-14. All the six items were retained, as their loadings were higher than 0.60. The same scenario happened for the MIC construct. All MIC items of MIC1-MIC9 were kept, as they exceeded the rule of thumb, as illustrated in Figure 6-15. Nonetheless, one item of the CIC (CIC1) was removed, as it had a loading lower than 0.60. The standardised loading estimates for the CIC are represented in Figure 6-16. Figure 6-17 shows the factor loadings of firm performance. All the items had ideal factor loadings of 0.70, therefore all the items were kept.

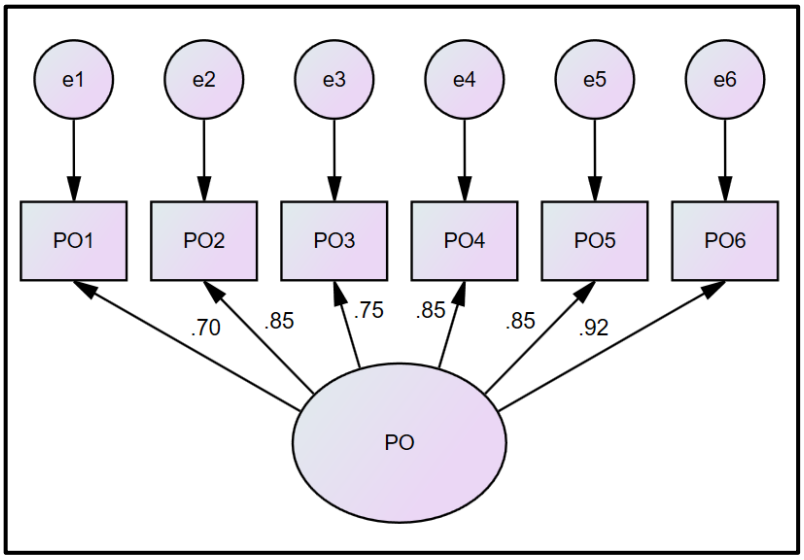


Figure 6-17: Factor loadings for firm performance

To summarise, out of 30 items, there were four for the HIC construct, six for the TIC construct, nine for the MIC construct, five for the CIC construct and six for the firm performance construct. These items were then submitted to CFA to assess the goodness of model fit.

6.3.2 Model fit

As mentioned in the previous chapter, Section 5.6, a total of 26 items from interaction capabilities were retained after the EFA during pilot testing. Before examining the measurement model through CFA (model fit), standardised loadings for each construct were assessed through convergent validity, which is discussed

in Section 6.3.1. Based on these results, one item each from the HIC and CIC constructs were removed due to loading below the 0.60 cut-off. As a consequence, interaction capabilities were left with 24 items. These 24 items and six items that represented firm performance were then submitted for CFA. To ensure a good model fit of a CFA model, several diagnostic measures were used in a number of runs. After dropping poor loadings items, discriminant validity is assessed in Section 6.3.3 and content validity is examined in Section 6.3.4.

In the first run, the model showed significant χ^2 at 993.523. The model fit of RMSEA=0.092, CFI=0.838 and TLI=0.821 indicated that they were below the agreed threshold, except for normed χ^2 which was within the suggested range guideline at (χ^2/df = 2.515). Following that, the diagnostic measures of standard residuals and modification indices were examined. Standard residuals results showed a large residual between MIC3 and MIC1, at 3.288, which brought this to the author's attention. In looking at the modification indices for the error terms, they indicated that there was a high modification index between these two items at 40.598. Furthermore, the loadings for both items were assessed. The result showed that MIC3 had a lower loading than MIC1; MIC3 thus became a candidate for deletion.

Removing MIC3 has not made any further improvement to the model fit indices. RMSEA, CFI and TLI were still below the suggested cut-off point. Results suggested TIC4 as a candidate for deletion based on the large residual between TIC4 and HIC2 at 2.775. In addition, the modification index indicated a high degree of covariance between TIC4 and TIC5.

In the next run, TIC5 was dropped. This was highlighted from the modification indices measure that showed a high modification index between TIC5 and HIC at 30.352. In addition, TIC5 had a greater than 2.5 residual with MIC4. Accordingly, this modification had provided little improvement to the model fit. The model χ^2 dropped to 731.618 with a 314 degree of freedom. The results showed little improvement of RMSEA, from poor fit (> 0.10) to mediocre fit (0.08-0.10). However, there was still no improvement to the CFI and TLI; they were still below 0.90. Hence, the diagnostic measures of standard residuals and modification indices were looked at again. Based on examinations of these measures, high

standardised residuals and a modification index between MIC1 and MIC2 were captured. Looking further, MIC1 had a loading of 0.616 which was lower than MIC2; MIC1 was thus removed from the analysis. As removing MIC1 had provided only a little improvement to the model fit, HIC2 was also removed as the item had a large residual of 2.612 with MIC4 and a loading of 0.598.

Given that there were no high standardised residuals for any pair of the items, and the model fit indices showed no further improvement, modification indices became the main focus. The modification indices table indicated that there was a very large modification index, namely for the covariance between the errors of measurement of PO1 and PO2 at 29.236. According to Aish and Jöreskog (1990), this error is also known as systematic measurement error. The error is associated with questionnaire responses that may derive from item characteristics or respondent characteristics. A high degree of overlap in item content may also trigger error covariances. High error covariances of PO1 and PO2 would be due to respondent characteristics, as both items asked for ROI. As there was no significant difference between ROI and ROI growth in the SME businesses, these two items were covaried. As CFI and TLI were still below the recommended threshold, the "Covariances" Section in the modification indices was further reviewed, and the parameter representing a covariance between e23 *("changing our culture and values when a larger customer requires it")* and e24 *("integrating our culture and values with those of larger customers")* appeared to be of interest, as it showed a high modification index of 24.519. These items appeared to assess the same indicator, which was on "*incorporating SME's culture with larger customers' culture and value".* Justification from the theory was used to further covary them. Covariation of these items improved the CFI to 0.902. Nonetheless, it did not improve the TLI.

Furthermore, the modification indices result was re-examined. In reviewing the modification indices related to the "Covariances", there was very clear evidence of a misspecification with the pairing error terms associated with items MIC8 and MIC5 at 21.206. Item MIC8 asked whether an SME is effective at assisting larger customers in their planning activities, while item MIC5 focused on whether the SME is effective at aligning its strategy with the strategy of a larger customer. It appeared that MIC8 was considered as part of MIC5, which was about the firm strategy.

Hence, the covariance between the two items was freed. As a result, TLI met the acceptable cut-off at 0.903. Consequently, all the model fit indices were within the recommended guidelines. Overall, the final measurement model fit indices (χ^2 = 518.498, df = 262, RMSEA = 0.074, normed χ^2 = 1.979, CFI = 0.916 and TLI = 0.903) showed that the model fits the data very well. The process steps followed to arrive at the final model are summarised in Table 6-7 and detailed in what follows.

After the model fit was assessed, as part of convergent validity, the AVE was calculated for each of the latent constructs. As shown in
Table 6-8, none of the constructs had an AVE below 0.50. Low AVE suggests than the items have more errors than variance explained in the latent construct. All the constructs achieved an AVE greater than 0.50, which suggested adequate convergence of the items (Hair *et al.*, 2010). Of the five constructs, firm performance and TIC showed an AVE higher than 0.60.

Table 6-7: CFA results for each modification process

Initial measurement model fit	Modifications			Revised measurement model fit
	Item	Indication	Action	
χ^2=993.523,df=395 *p*=0.000 RMSEA=0.092, Normed χ^2=2.515 CFI=0.838 TLI=0.821	MIC3	High standardised residuals covariances of 3.288 with MIC1	Drop MIC3	χ^2=913.432,df=367 *p*=0.000 RMSEA=0.091, Normed χ^2=2.489 CFI=0.846 TLI=0.830
		Loading – 0.623		
	MIC1	High correlated error of 40.598 with e13 (MIC3)	No change	
		Loading – 0.653		
χ^2=913.432,df=367 *p*=0.000 RMSEA=0.091, Normed χ^2=2.489 CFI=0.846 TLI=0.830	TIC4	High standardised residuals covariances of 2.775 with HIC2	Drop TIC4	χ^2=815.426,df=340 *p*=0.000 RMSEA=0.088, Normed χ^2=2.398 CFI=0.860 TLI=0.844
		High correlated error of 37.033 with e9 (TIC5)		
χ^2=815.426,df=340 *p*=0.000 RMSEA=0.088, Normed χ^2=2.398 CFI=0.860 TLI=0.844	TIC5	High correlated error of 30.352 with HIC	Drop TIC5	χ^2=731.618,df=314 *p*=0.000 RMSEA=0.086, Normed χ^2=2.330 CFI=0.871 TLI=0.856
		High standardised residuals covariances of 2.538 with MIC4		
χ^2=731.618,df=314 *p*=0.000 RMSEA=0.086, Normed χ^2=2.330 CFI=0.871 TLI=0.856	MIC1	High standardised residuals covariances of 2.592 with MIC2	Drop MIC1	χ^2=667.999,df=289 *p*=0.000 RMSEA=0.085, Normed χ^2=2.311 CFI=0.879 TLI=0.864
		Loading – 0.616		
	MIC2	High correlated error of 27.771 with e11 (MIC1)	No change	
		Loading – 0.687		
χ^2=667.999,df=289 *p*=0.000 RMSEA=0.085, Normed χ^2=2.311 CFI=0.879 TLI=0.864	HIC2	High standardised residuals covariances of 2.612 with MIC4	Drop HIC2	χ^2=625.132,df=265 *p*=0.000 RMSEA=0.087, Normed χ^2=2.359 CFI=0.882 TLI=0.866
		Loading – 0.598		
χ^2=625.132,df=265 *p*=0.000 RMSEA=0.087, Normed χ^2=2.359 CFI=0.882 TLI=0.866	PO1 & PO2	High correlated error of 29.222 between y1 (PO1) and y2 (PO2)	Covary PO1 and PO2	χ^2=593.171,df=264 *p*=0.000 RMSEA=0.083, Normed χ^2=2.247 CFI=0.892 TLI=0.877
χ^2=593.171,df=264 *p*=0.000 RMSEA=0.083, Normed χ^2=2.247 CFI=0.892 TLI=0.877	CIC5 & CIC6	High correlated error of 24.519 between e23 (CIC5) and e24 (CIC6)	Covary CIC5 and CIC6	χ^2=549.368,df=263 *p*=0.000 RMSEA=0.078, Normed χ^2=2.063 CFI=0.906 TLI=0.893
χ^2=549.368,df=263 *p*=0.000 RMSEA=0.078, Normed χ^2=2.063 CFI=0.906 TLI=0.893	MIC8 & MIC5	High correlated error of 21.206 between e18 (MIC8) and e15 (MIC5)	Covary MIC8 and MIC5	χ^2=518.498,df=262 *p*=0.000 RMSEA=0.074, Normed χ^2=1.979 CFI=0.916 TLI=0.903

Table 6-8: Summary statistics (Convergent validity)

Construct	AVE	Composite reliability	Range of factor loadings
HIC	0.59	0.81	0.61-0.85
TIC	0.66	0.90	0.71-0.88
MIC	0.53	0.90	0.61-0.82
CIC	0.59	0.91	0.59-0.85
Firm performance	0.67	0.94	0.66-0.93

Another indicator of convergent validity is that of reliability. It is debatable, however, which reliability measures should be considered. In any reliability estimates, a good reliability is 0.70 or higher. Reliability of 0.60 to 0.70 would still be acceptable, as long as the other indicators in a model's construct validity are good (Hair *et al.*, 2010). For this empirical work, reliability was assessed using composite reliability. As presented in

Table 6-8 all composite reliability values exceeded 0.70, indicating evidence of convergent validity.

6.3.3 Discriminant validity

All the latent variables should also be assessed for discriminant validity, which denotes whether a particular construct is distinct from other constructs (Hair *et al.*, 2010). There are several ways to assess this validity; however, the most common way is to compare the correlations of two constructs with the square roots of the AVE. For any given construct, a higher square root of AVE than any correlation between that construct and any other construct suggests that it is distinct. The rationale is that more variance should be explained by a latent construct's items measure than by another construct's share (Hair *et al.*, 2010).

Table 6-9: AVE and correlations

Construct	Mean	Std deviation	HIC	TIC	MIC	CIC	Firm performance
HIC	4.06	1.80	**0.77**				
TIC	4.20	1.88	0.74	**0.81**			
MIC	4.14	1.50	0.69	0.63	**0.73**		
CIC	4.41	1.59	0.56	0.48	0.67	**0.77**	
Firm performance	4.27	1.03	0.38	0.26	0.31	0.24	**0.82**

Diagonal entries are the square roots of the AVEs, which is the variance shared between constructs and their measures. Off diagonals are the correlations between constructs. Diagonals should be larger than any corresponding row or column entry, so as to support discriminant validity.

As presented in Table 6-9, the AVE for each construct was higher than the inter-correlations, suggesting support for discriminant validity.

6.3.4 Content validity

In this study, content validity was also assessed. Content validity refers to the extent to which the items reflect the nature of the construct domain. These items are agreed and evaluated through a judgemental process, as this does not involve any statistical test (Garver and Mentzer, 1999; Brandon-Jones, 2017). Also in this study, a structured interview, Q-sort and a scale pretest were used to achieve content validity. The detailed process has been explained in detail in Section 3.4. The importance of establishing content validity has been highlighted in many studies, as lack of content validity leads to meaningless analysis (Ahire *et al.*, 1996). Thus, content validity should be assessed ahead of any theoretical testing (Hair *et al.*, 2010).

6.4 Structural model

Following the two-step approach of Anderson and Gerbing (1988), a structural model was examined to identify the correlational relationships between two constructs. Before examining the relationships, the model was built, as illustrated in Figure 3-7. The following steps were taken in order to build the model. First, the mean for each of the constructs (HIC, TIC, MIC, CIC and firm performance) was computed. Second, the sum of 11 items in the participation scale was calculated. Based on the sum score, a histogram of the participation was examined in order to see the distribution of the score, as presented in Figure 6-18.

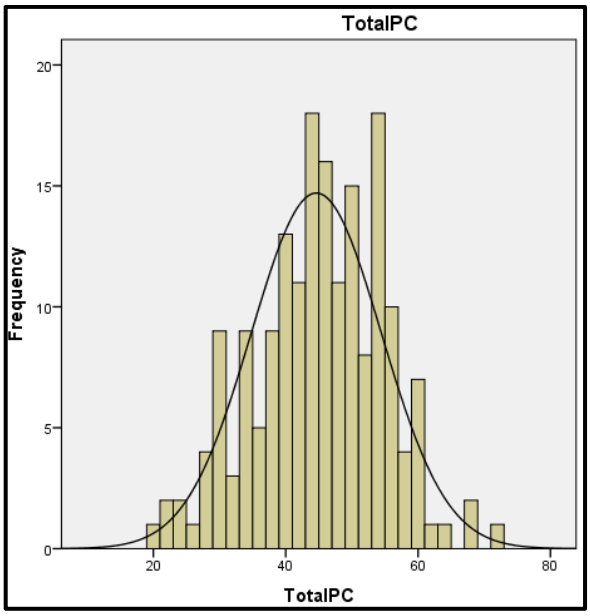


Figure 6-18: Current participation histogram

Based on the distribution, percentile was used to create four indices: low_participation=20-39, medium_low participation=40-45, medium_high participation=46-52 and high_participation=53-71. With these, a composite variable of participation was formed. Then, the structural relationships were specified using path analysis as presented in Figure 3-7.

6.4.1 Structural model results

As shown in Table 6-10, the path analysis presented the selected fit statistics. Overall, the model had χ^2 =16.006, (df=7) with significant *p* value, indicating that the actual observed matrix matched the estimated matrix. Hence, other fit statistics were examined (Garver and Mentzer, 1999; Hair *et al.*, 2010). In absolute fit indices, RMSEA and normed χ^2 were assessed. Even though the RMSEA value of 0.085 was above 0.08, it was still considered to be acceptable. MacCallum *et al.* (1996) have indicated RMSEA values of 0.08-0.10 to be a mediocre fit and values of above 0.10 to be a poor fit.

Table 6-10: Structural paths

Hypothesis	Structural Paths			SMEs' participation model
	Controls			
	Micro	→	Firm performance	-0.183**
	Medium	→	Firm performance	0.057 (NS)
	High technology	→	Firm performance	-0.007 (NS)
	Medium low technology	→	Firm performance	0.066 (NS)
	Low technology	→	Firm performance	0.119*
	Interaction capabilities			
H1	HIC	→	Participation	-0.088 (NS)
H2	TIC	→	Participation	0.109 (NS)
H3	MIC	→	Participation	0.180*
H4	CIC	→	Participation	0.072 (NS)
	HIC	→	Firm performance	0.322***
	TIC	→	Firm performance	0.056 (NS)
	MIC	→	Firm performance	-0.043 (NS)
	CIC	→	Firm performance	0.045 (NS)
	Participation			
H5	Participation	→	Firm performance	0.122*
	Model fit statistics			
	Chi-square			16.006
	Degree of freedom			7
	RMSEA			0.085
	Normed chi-square			2.287
	CFI			0.976
	TLI			0.813
	Variance explained (R^2)			
	Participation			0.06
	Performance outcomes			0.22

Note: ***$p \leq 0.01$; **$p \leq 0.05$; *$p \leq 0.1$. NS: Not significant

The next fit index is normed χ^2. Normed $\chi^2 = 2.287$, i.e. below 3.0, suggesting a better model fit. The next statistics were from the incremental fit indices. The CFI value of 0.976 appeared to be quite high, which met the stringent threshold of 0.95 (Hu and Bentler, 1999). However, the other incremental fit indices of TLI=0.813 were below the suggested cut-off value of 0.90. Although the TLI value was lower than expected, incremental fit indices were still considered to be acceptable, as one of the indices did meet the cut-off value. In summary, it can be concluded that the structural model has attained model fit.

6.4.2 Hypotheses testing

To test the proposed relationships, the SEM software of AMOS was used. In order to make this more clear and easy to understand, the conceptual framework was divided into two. The first part of the discussion focused on the results of the direct relationships between a) interaction capabilities with firm performance and b) participation with firm performance. The second part presented the mediation results. Those results showed that MIC (*b*=0.180, p <0.1) is significantly associated with participation. This supports the H_3 which was "*MIC is positively associated with participation*". *Other* relationships between HIC, TIC, and CIC and participation were found to be statistically insignificant with participation. Hence, H_1: "*HIC is positively associated with participation*" (*b*=-0.088; n.s.)", H_2: "*TIC is positively associated with participation*" (*b*=0.109; n.s.), and H_4: "*CIC is positively associated with participation*" (*b*=0.072; n.s) were not supported. The relationship between participation and firm performance was also found to be statistically significant with (*b*=0.112 $p \leq 0.1$). In terms of control variables, only low technology intensity was significant (*b*=0.119; $p \leq 0.1$) suggesting that SMEs of low technology performed better than SMEs with medium-high technology. The results are tabulated in Table 6-10.

To test the mediation effect of participation, the approach from Zhao, Lynch and Chen (2010) was followed, due to shortcomings of the Sobel and Baron-Kenny approaches. To identify the mediation relationships, the decision tree was followed, as illustrated in Figure 6-19. The decision tree can be divided into two big steps: first, to determine the significance of the indirect effect of $a \times b$; second, to identify the types of mediation and non-mediation by assessing the significance of the direct effect (*c*). By following these steps, five types of mediation can be identified.

First, complementary mediation implies the existence of the mediated effect of a (*a* x *b*) and a direct effect (*c*) and both point in the same direction. The second type is competitive mediation in which the mediated effect and direct effect both need to exist but point in the opposite directions. Next, “indirect only mediation” is when mediated effect exists, but not for direct effect. Direct only, non-mediation is the fourth type of mediation; for this type, no mediation effect exists, but direct effect does. The last type is no effect non-mediation where neither the direct effect nor the indirect effect exists (Zhao *et al.*, 2010).

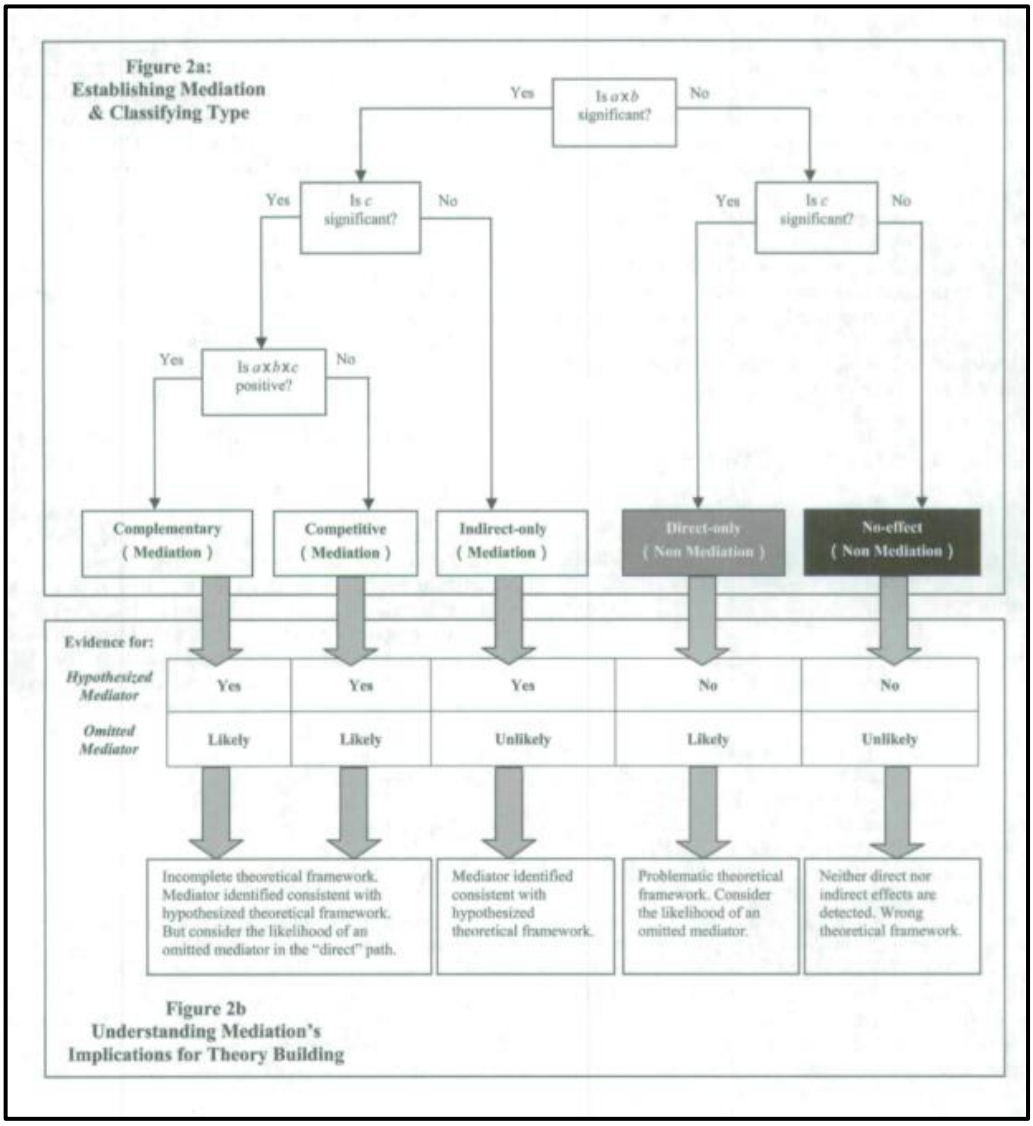


Figure 6-19: Decision tree for establishing and understanding types of mediation and nonmediation (adapted from Zhao *et al.*, 2010)

Among the four paths linking the interaction capabilities to the firm performance through participation, only the MIC was found to be significant. The HIC, TIC and CIC constructs were found to be non-significant. This result empirically documented that participation mediates the relationships between MIC and firm performance, supporting $H6_c$. Hence, indirect only mediation or full mediation was achieved (Zhao *et al.*, 2010; Nitzl, Roldan and Cepeda, 2016). Regarding H_{6a}, direct only non-mediation was established as the direct effect between HIC and firm performance was found to be significant, whereas the indirect effect was found to be non-significant. Hence, H_{6a} was rejected. For the other two hypotheses H_{6b} and H_{6d}, neither the direct effect, nor the indirect effect was found to be significant. Therefore, H_{6b} and H_{6d} were rejected. The mediation result is tabulated in Table 6-11.

Table 6-11: Mediation results

Relationship	Direct	Indirect	Type of mediation
HIC → PC → PO	0.322***	-0.011	Direct only (Non-mediation)
TIC → PC → PO	0.056 (NS)	0.013	No-effect (Non-mediation)
MIC → PC → PO	-0.043 (NS)	0.015*	Indirect only (Mediation)
CIC → PC → PO	0.045 (NS)	0.009	No-effect (Non-mediation)

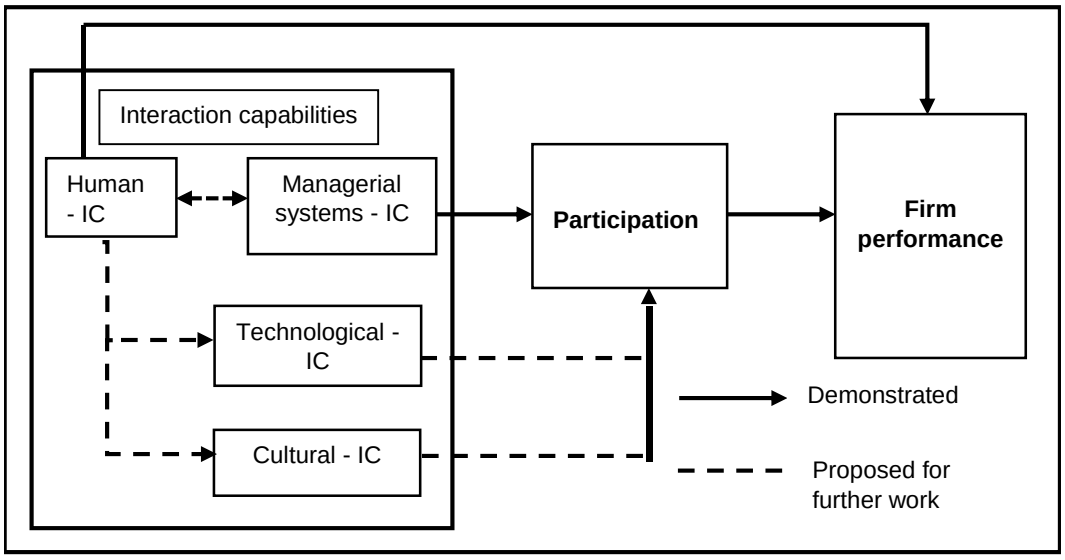


Figure 6-20: Phase 2 - Revised conceptual framework

Based on the hypotheses testing, results showed that only two variables – HIC and MIC – influenced participation and firm performance. Specifically, the results posited that HIC affected firm performance whilst MIC affected participation. Further, the results showed participation to be a mediator variable for the

relationships between MIC and firm performance. These results are illustrated as shown in Figure 6-20.

6.5 Final scale of interaction capabilities

Incorporating the changes made in the initial scale development, which was carried out with a sample of 41 respondents and 181 respondents for the main empirical work, a total of 19 items were retained, representing three for HIC, four for TIC, seven for MIC and five for CIC. Rigorous analyses of EFA and CFA were used to assess the measurement properties of these items. A factor loading of 0.50 was used to identify poor loading items, whereas a higher standardised estimate of 0.60 was used as an acceptable cut-off in the main empirical work. In addition, diagnostic measures of standardised residuals and covariances were referred to in order to improve the model fit. As a result, a valid scale of interaction capabilities was developed, as illustrated in Figure 6-21. Here, subjective measures were adopted, following precedents set by other scholars in high impact journals (Kim, 2006; Alegre *et al.*, 2011; Kim *et al.*, 2011; Pavlou and El Sawy, 2011; Wamba *et al.*, 2017) .

Please rate the effectiveness of your firm in the following activities, relative to your major competitors (1=not effective at all to 7=extremely effective).

Human interaction capability (HIC)

HIC1 Developing internal skills and knowledge during joint projects with larger customers
HIC4 Forming cross-functional, cross-hierarchical teams with larger customers to facilitate knowledge exchange
HIC5 Working with larger customers to build new or common areas of expertise

Technological interaction capability (TIC)

TIC1 Developing new ways to integrate our technological systems with those of larger customers
TIC2 Customising our technological systems to those of larger customers
TIC3 Developing our systems/technology according to larger customers' wishes
TIC6 Adapting our technologies to new large customers to provide customised service offerings

Managerial systems interaction capability (MIC)

MIC2 Developing business plans in collaboration with larger customers
MIC4 Including larger customers in our goal-setting activities
MIC5 Aligning our strategy with the strategy of larger customers
MIC6 Understanding larger customers' strategic plans
MIC7 Incorporating larger customer requirements into our plans, policies and objectives
MIC8 Assisting larger customers in their planning activities
MIC9 Responding to larger customers' planning activities

Cultural interaction capability (CIC)

CIC2 Developing common working culture and values with larger customers
CIC3 Adapting to larger customers' values and culture
CIC4 Treating larger customers as friends irrespective of their culture
CIC5 Changing our culture and values when a larger customer requires it
CIC6 Integrating our culture and values with those of larger customers

Figure 6-21: Final scale for interaction capabilities

6.6 Summary

This chapter has presented the main findings of the study. The findings were gathered from 181 respondents who covered the descriptive statistics, the measurement model, the structural model and the final scale validation and refinement. The descriptive statistics revealed that a large percentage was represented by small companies (47%). The majority of the companies were over 20 years old and held a legal status of limited company, with most of them generating a turnover of less than £10million. Most of the respondents who responded to the questionnaire were in executive roles. Moving on to the descriptive statistics of HVM, the average score for the HVM definition was higher than interaction capabilities, participation and firm performance. Most of the respondents agreed that HVM has three elements: a) businesses with the application of new processes and technologies, b) involved in traditional, new and emerging industries, and c) require highly skilled employees or high levels of investment. Regarding the basis of competition, SMEs in the UK tend to focus on

being responsive and flexible rather than giving priority to cost and quality. This chapter has also confirmed that a good model fit was obtained through the assessment of the measurement model. As such, a structural model was tested to examine the relationship between variables. The testing confirmed that HIC and participation were significantly correlated to firm performance, and that participation mediated the relationships between MIC and firm performance. Finally, the chapter presented a valid instrument for interaction capabilities after the scale was refined a few times in several stages.

7 PHASE 3 – QUALITATIVE RESEARCH: CASE STUDIES RESULTS

7.1 Introduction

This chapter analyses the results of the two case studies. Sections 7.2 and 7.3 describe within-case analysis of a high participation firm and a low participation one. As discussed in Section 3.6.1, low participation firms scored below 45 whereas high participation firms scored above 45 for their participation. The structure for both sections is the same as presented in Figure 7-1. Each section begins with a research context overview, followed by the research content of each case study. Within the research context, company structure, business strategy, customer base and growth strategy are covered. In contrast, for the research content, survey findings are validated using verbatim interview extracts.

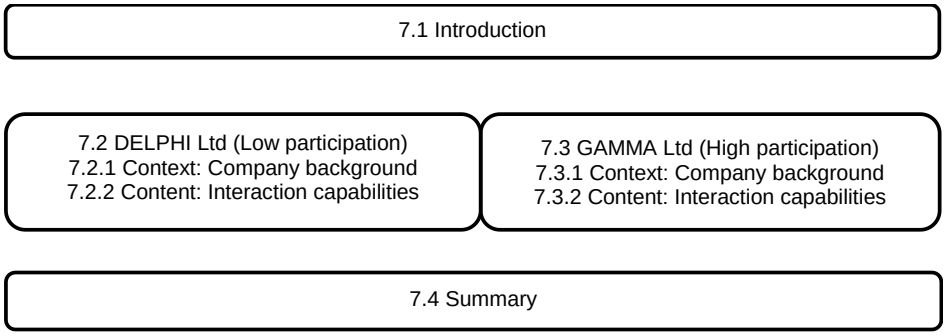


Figure 7-1: Structure of Chapter 7

7.2 DELPHI LTD (Low participation)

This section focuses on the firm with low participation. The firm scored 43 for the participation. Section 7.2.1 provides a more detailed overview of Delphi Ltd in terms of the company structure, company's mission and vision, the company's customers as well as its growth strategy. The purpose of Section 7.2.1 is to present some contextual factors that may influence Delphi Ltd's effectiveness of interaction capabilities. Section 7.2.2 aims to seek qualitative explanations for the results collected from the survey questionnaire.

7.2.1 Context: Company background

Delphi Ltd is a materials technology firm that specialises in coatings. The firm has a unique amorphous diamond material that can provide durable and reliable coatings. The firm was founded in 2005 through a funding round specialising in the early stage technology and start-up business. With a sufficient fund, the firm managed to move from technology-based to the manufacturing industry. In 2009, Delphi Ltd established its first UK manufacturing plant in Towcester where it is equipped with processing and testing equipment. In 2010, the firm was awarded the ISO 9001 and ISO 14001 standards, which describe the firm's structure.

The firm has a management group of three, as presented in Figure 7-2. As well as being responsible for the overall business, the CEO is responsible for the accounts payable, sales and marketing as well as manufacturing. Apart from the CEO, Delphi Ltd has a sales administration manager who is responsible for the human resources, administration, accounts receivable and exports, whereas the engineering manager is responsible for the quality department and manufacturing operation. Apart from the management group, the firm has seven direct employees and outsources non-core activities such as accounting, human resources and quality management. The firm's total turnover in 2017 was half a million pounds (approximately 579 thousand euros).

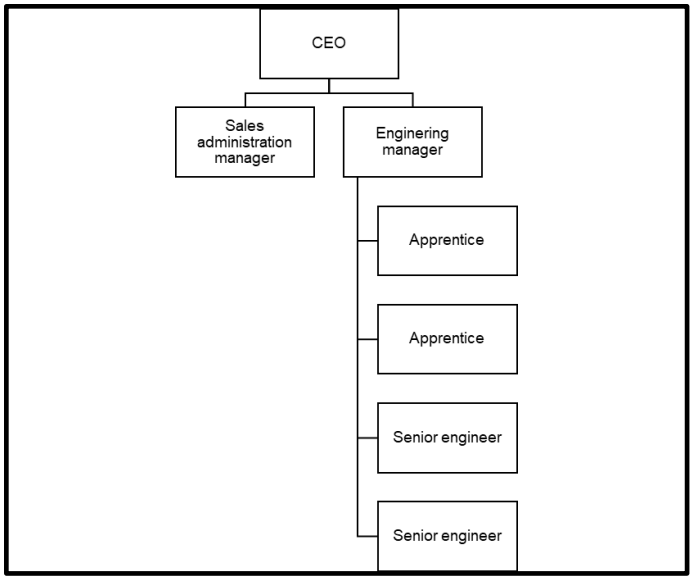


Figure 7-2: Delphi Ltd organisational structure

Although the total turnover was less than a million pounds (approximately 1.1 million euros), Delphi Ltd aims to have total turnover of ten million pounds (approximately 11.5 million euros) and be a large player in coating provision. In order to achieve, the firm first needs to accomplish its mission to be a specialised provider of coating solutions to different market sectors and value added market sectors. Diverse market sectors would reduce the dependency of the firm on a particular sector, as total discontinuance of that sector would affect the survival of the firm. Currently, Delphi Ltd operates in oil and gas, electronics, aerospace and chemicals processing. Delphi Ltd still competes with other coating companies even though the firm serves niche markets. Nonetheless, Delphi Ltd does not really encounter any issues with these coating companies as the company provides unique coatings or because the coatings from other companies do not work well for customers.

A Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis was conducted with the CEO during the scoping study. A summary of the SWOT analysis is presented in Table 7-1. The firm's product development strategy has given the firm flexibility to identify markets in which it is easy to provide coatings. For example, a flat shape is easier to coat than a complex shape. In addition, the strategy of giving less information on its website provides an opportunity for Delphi Ltd to have conversations with technical decision makers. These opportunities have made product innovation one of the firm's strengths. Delphi Ltd can easily adapt its coating with the right amount of R&D resources allocated.

Table 7-1: SWOT analysis of Delphi Ltd

Strengths	**Weaknesses**
Product innovation Speed of reaction Patented processes	ISO9001: 2015 Size of firm Critical mass Financial constraint No interest in banks
Opportunities	**Threats**
Product development strategy Electronic market Conversation with technical decision makers	Small team General Data Protection Regulation (GDPR) regulations Largest customers are from the States

Delphi Ltd claimed that being smaller than ten employees is its major weakness. This is due to the critical mass that the firm faces when one or two people are away

from the business. This will put a strain on the other staff but on the other hand, being a low participation firm will require the staff to be flexible in their working. Moreover, being a low participation firm will not only weaken it but also becomes a threat as it impedes the firm from succeeding in a certain strategic direction. For instance, the firm has little or lost interest in banks as they are not interested in micro size, or firms with less than five million pounds (approximately 5.7 million euros). Worsening this situation, the firm has not received any funding for the last five years, which makes it difficult for the firm to undertake R&D.

In looking into its customer base, Delphi Ltd does not really define its customers but most importantly, the firm retains its product differentiation in order to ensure it can stand up to the large companies. Through features differentiation in its coating, Delphi Ltd was able to persuade a helicopter company and obtained a three-year contract without any conditions. Initially, the helicopter company included a condition that Delphi Ltd had to pay for the scrap cost but withdrew the condition due to the unique coating. To ensure its long-term survival, Delphi Ltd will ensure that 80% of its business is not tied up with one customer. Currently, Delphi Ltd has 50 different customers and its major customers only account for 30% of its revenue. However, it takes various timelines for the firm to build relationships with major customers. For the initial relationships, it would take a month to a year to win an order. In a project-based situation with an oil and gas company, the firm took two and a half years from the initial process to production stage but lost the business due to a trial failure. To prevent this kind of situation from recurring, the firm filled the parts enquiries to the front-end of the pipeline. This will ensure that the firm receives 6- 8% out of all enquiries. For example, as shown in Figure 7-3, the firm can still hold three or four projects if they allocate fifty prospective projects at the initial stage.

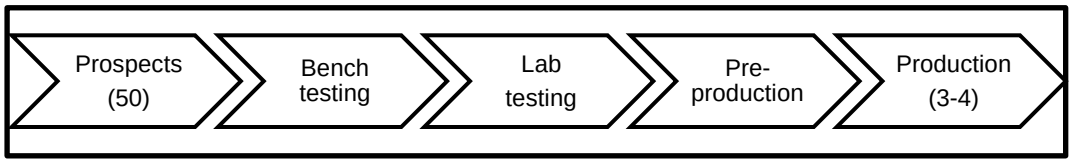


Figure 7-3: The coating process

Apart from the above strategy, Delphi Ltd has used different marketing strategies to sustain its business. Well known as the most risky strategy under Ansoff's

matrix, Delphi Ltd has avoided using diversification strategy to grow the business. Instead, the firm focuses on the other three strategies which are market penetration, product development and market development strategy. For the market penetration strategy, Delphi Ltd continues to sell its coating to existing mechanical seal markets because the coatings' lifetime can be prolonged in dry running and marginal lubrication conditions. Delphi Ltd also actively updates its coating for new markets, such as infrared analysis, and watches for new geographical markets or new market segments, such as the electronics industry.

7.2.2 Content: Interaction capabilities

In this section, qualitative explanations provide further support for relationships found in quantitative methods. After conducting the interviews, the framework was captured as illustrated in Figure 7-4.

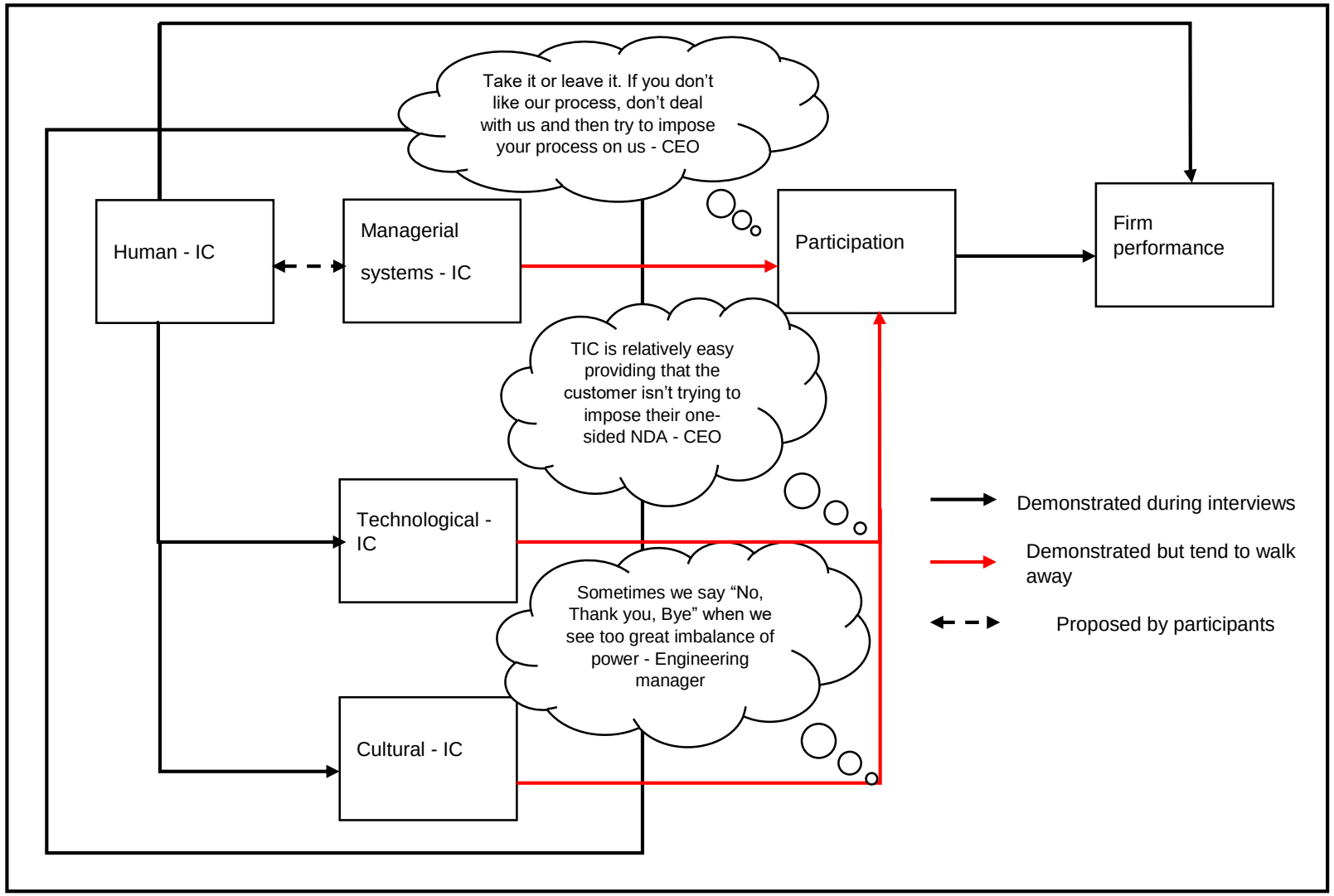


Figure 7-4: Delphi Ltd conceptual framework

7.2.2.1 HIC and firm performance

Delphi Ltd tended to put a higher emphasis on HIC as the firm is more concerned with its profitability than increasing participation with larger customers. From the three interviews conducted with senior management teams (SMTs), two of them tended to focus more on HIC than other interaction capabilities. To increase participation in larger customers' SCs, SMEs will need to align their systems with larger customers' systems, which will require a huge investment by Delphi Ltd. Delphi Ltd is confident that its performance can still be improved regardless of the size of the customers and this cannot be achieved without HIC in place. HIC has been considered as a cornerstone for SMEs to succeed in their business. Delphi Ltd found the ability to talk to the large customers' engineers to be crucial in order to improve the firm's sales.

"Yes it (HIC) will. You can't do it without it (HIC). I don't think you can do business without that. …. That's the foundation stone. If that does not work in the first place, you've got nothing" (CEO).

Bilateral development of HIC between Delphi Ltd and its larger customers has played a crucial role in improving Delphi Ltd's firm performance. The low participation firm found it easy to develop HIC with its larger customers. The firm has done so by interweaving its engineers with larger customers' engineers on projects. Usually, large customers come to Delphi Ltd with a problem and seek solutions because of its expertise in coatings. Delphi Ltd has successfully enhanced its skills, knowledge and expertise through joint projects with larger customers. In the projects, both companies will share results and knowledge; this has led to a new area of knowledge to be explored.

"Because we have some coatings in advance, we would like to develop or offer some solutions to other companies. Often, in the R&D stage, these companies try to look to different markets and products. Here, we could be part of the solution provider because these companies don't have ideas and expertise. Usually, our CEO will talk at Conferences and share some information." (Engineering manager, Delphi Ltd).

In the early stage of the relationships, Delphi Ltd engages with customers through knowledge exchange. Delphi Ltd has effectively driven its HIC by offering its expertise and knowledge to large customers at the Conferences. The sales administration manager of Delphi Ltd highlighted that the firm will identify risks and opportunities during its quarterly management meeting. From these opportunities, the firm will find any relevant Conferences at which to present its technical papers. In addition, Delphi Ltd will also approach potential, large customers by talking to the engineers to understand their business, culture and strategy.

7.2.2.2 MIC, participation and firm performance

Delphi agreed that low participation firms could grow their business in terms of product, market or diversification if they align to larger customers' processes. As Delphi Ltd tended to operate on a project basis, strategic planning and collaboration happened in the form of customer R&D rather than long-term production volume. Delphi Ltd has used technical conferences as a main platform to find new large customers. Within the project-type interactions, strategic planning and collaboration happened after both companies agreed with each other's processes during their visits. During the visit, larger customers would assess Delphi Ltd facilities and during Delphi Ltd's visit, the firm would check large customers' processes. Once both companies agreed, R&D action plans would be developed to ensure both companies achieve mutual benefits.

No collaboration takes place between companies after the project ends. Usually, collaboration only occurs during the project in which the firm's engineer works together with the larger customer's engineer. After the project ends, no communication happens between companies but Delphi Ltd will do a follow-up with a particular customer after three months to re-build the relationship. In doing the follow-up, Delphi Ltd will check with the customer on the coatings and whether there is a new project to be carried out together.

"If the customers are happy, they come back to us. We see them at Conferences and try to maintain the relationship. We also contact them every three months." (Engineering manager, Delphi Ltd).

However, the qualitative investigations revealed that Delphi Ltd found it difficult to acquire MIC due to the high cost in developing it. Hence, less emphasis has been put on MIC by Delphi Ltd. In order to acquire MIC, a low participation firm would need to follow and align its processes with larger customers' processes; this will impose extra costs on the firm as a low participation firm has limited resources and does not have people to do this full-time, as demonstrated by the following quote:

"This area here (MIC) can just swamp you. Somebody like the helicopter company has a portal that you are supposed to reference every month, update and send documents. I do not want to be aligned with their management systems. I cannot afford to be. I cannot afford to have somebody full-time." (CEO).

Delphi Ltd is confident that the firm has its own processes that have been audited. Thus, large companies need to accept those or otherwise, small companies will simply step away from larger customers. In addition, Delphi Ltd feels that it would take time for larger companies to agree on something due to the different strategic priorities that they have. For instance, larger customers may have little or no time to undertake R&D because of other priorities or awaiting a budget from the top management level. This delays the collaboration between both companies.

7.2.2.3 HIC as an antecedent to TIC and CIC

The development of TIC and CIC seemed to be influenced by HIC. Delphi Ltd is aware that the firm needs to have HIC in order to have technological co-development with large customers.

"For example one of the big seal companies based in Slough has own coating and the company has issues in one area of the seal faces. We did a two-year project with them whereby the company would send us seal faces, we would coat them with a particular recipe, the customer would take and test them, then we would get the result back. The customer would say ok, we got a good result for this bit but not a very good result for this bit and we would say let's try not to pin the coating. We've been doing a lot of that with them for maybe over nearly two years. We never fully solved the problem but we have got close to their coating." (Sales administration manager, Delphi Ltd).

However, co-development will only take place between both companies if large customers are able to provide good IP rights. There are cases where larger customers try to intimidate SMEs by taking the IP rights, or imposing one-sided non-disclosure agreement (NDAs) on SMEs. Without a good knowledge, SMEs might not be able to protect their IP rights. Moreover, Delphi Ltd is willing to walk away if large customers do not provide a good IP rights or a fair NDA. This happened when some of the big companies in the States tried to illegally adopt Delphi Ltd technology.

For the CIC, Delphi Ltd agreed that without HIC, it would be hard for the firm to understand the culture of its large customers. Even though most of Delphi Ltd staff do not have any interactions with the customers, the firm still educates the staff about customers, their expectations, respecting their requirements and confidential information, such as agreements.

"For the cultural side of things, we definitely need a human understanding." (Sales administration manager, Delphi Ltd).

In contrast, Delphi Ltd tends to walk away if large customers act abusively. The corporate culture of large customers will begin to appear when a technological solution does not work as expected. This happened when one of Delphi Ltd customers used its big company's strategy to overpower Delphi Ltd all the time.

7.3 GAMMA LTD (High participation)

This section focuses on a high participation firm. The firm under the pseudonym "Gamma Ltd" scored 57 for the participation. Similarly to Section 7.2, this section is structured into two main sub-sections: Section 7.3.1 provides detailed descriptions of Gamma Ltd and Section 7.3.2 presents qualitative explanations for the survey results.

7.3.1 Context: Company background

Gamma Ltd is a private holding company that specialises in plastic injection moulding, toolmaking and the assembly business. The company was founded in 2010 and has eight SMTs, a chief executive, a finance director, a group SC, a technical, a sales and three subsidiary directors. The company has three locations with two of them operating in the West Midlands and the other one operating in the East Midlands. The company currently have over 125 full-time employees, 35 indirect employees and 25 temporary workers. The annual turnover of the company was 10.6 million pounds (approximately 12.2 million euros) in 2017. The company managed to double its turnover in 2017 from 5.6 million pounds (approximately 6.4 million euros) in 2016 and this is expected to increase by 30% in 2018.

Currently, the business operates in a wide range of sectors such as automotive, aerospace, automation, defence, electrical, housing and construction, cosmetic retail display and sports. Among these sectors, automotive and cosmetic retail display are the major sectors with cosmetic retail display as a largest sector that the company supplies. Overall, the growth of these sectors is stable. Cosmetic retail display has seen a stable growth whereas the automotive sector has experienced a negative growth. The biggest competitors for the Gamma Ltd business are plastics injection moulding companies.

A SWOT analysis was conducted with the CEO during a scoping study, and a summary is tabulated in Table 7-2. The company is aware that size is one of the company's strengths. As a result, Gamma Ltd strove to grow its business from an SME to a medium enterprise (ME). In 2010, the company only operated in one site but after two years of operations, Gamma Ltd expanded its business to another manufacturing site in West Midlands. Due to the strong mergers and acquisitions (M&A) background that the CEO has, Gamma Ltd acquired another company in the East Midlands. The company is planning to open another plant in Central Europe in 2019. Apart from its ability to scale up, the company is well-equipped with capital equipment. Its expertise in M&A has enabled the company to secure finance more easily than its competitors. Although the company has scaled up successfully, it is still exposed to any threats as a highly leveraged business. This

is because a highly leveraged business is more likely to run out of cash and this can be a threat, especially in difficult times.

Table 7-2: SWOT analysis of Gamma Ltd

Strengths	**Weaknesses**
Ability to scale up Well-equipped with capital equipment Financially in a good position	Operations Management Poor in operator training No “right” people in the “right” position for long enough
Opportunities	**Threats**
Rationalisation of three sites into one Acquisition pipeline Further investment in automation	Time – Running out of cash Highly leveraged balance sheet can be a weakness in difficult times

Though Gamma Ltd has grown successfully for the last eight years, the company is still facing problems related to operations and management. Within operations, the company faces quality, efficiency and training issues. Quality can be the biggest differentiator in any business; however, for businesses to achieve zero-defects is a target. Gamma Ltd has therefore constantly evolved and developed its quality standards. The company has used single-minute exchange of die (SMED), Kaizen and process maturation, to achieve optimum efficiency. In addition, Gamma Ltd has also faced challenges in leveraging skills and development of its operators. The company has difficulty in retaining the “right” people in the “right” position because skilled people prefer to grow in LEs or MNCs than in SMEs. In order to solve the manning issue, Gamma Ltd took steps to rationalise its sites from three to one. With one site, the company is confident that it will be easier to manage staffing issue and to enforce common practices and controls.

Moving to its customer base, Gamma Ltd has a wide range of customers from different sectors, such as automotive, electronics, medical, automation and defence. The company defines its customers in two ways: the first is based on the size of the company and the second through the amount of business that the customers give to Gamma Ltd. The company continuously aims to supply from small to medium companies and from medium to large companies or MNCs. The key customers of Gamma Ltd are predominantly Tier 1 automotive and point of sale designers and assemblies. Nearly half of Gamma Ltd’s revenue is accounted for by point of sale and the remaining revenue is accounted for by other Tier 1

automotive – between 5 and 10% for each of the customers. Gamma Ltd has taken different time frames to build relationships with its key customers; for instance, recently the company built a relationship with a new Tier 1 automotive supplier within three weeks. The longest relationship has been built over eight years with another Tier 1 automotive supplier.

Although Gamma Ltd has managed to retain some of its customers for eight years, the company still faces some important issues in serving these key customers, including quality and late deliveries. Non-conforming products and poor labelling are also quality issues that are faced by the company, whereas improper planning and control are problems that cause late deliveries. Several measures have been taken by Gamma Ltd to mitigate the problems; however, top-level discussions and dealing with unhappy customers are the top measures that have been focused on by Gamma Ltd to solve the issues.

Being an SME has allowed Gamma Ltd to be flexible in doing business. The company can change direction quickly. Similarly to Delphi Ltd's strategy, the company has changed its growth strategy according to the situations. Gamma Ltd growth strategy began with a market penetration and market development strategy. The company has expanded rapidly from just being in the West Midlands to being in the East Midlands and now it plans to open another site in Central Europe in 2019. The establishment of a Central Europe site will position Gamma Ltd closer to the end customers as well as Tier 1 suppliers. From these two strategies, Gamma Ltd is now moving to product development or diversification strategy. Current Gamma Ltd business is providing plastics injection moulding, tool-making, assembly and printing services. Now, the company is diversifying its business from service-based to product-based. Gamma Ltd is looking to develop its own product line rather than just being a contract manufacturer. However, in order to do so, the company needs to leverage its knowledge of plastic injection moulding.

7.3.2 Content: Interaction capabilities

This section seeks to provide qualitative explanations for the refined conceptual framework gathered from the survey questionnaire. From two interviews conducted, i.e. with the CEO and a group finance director, a conceptual framework was captured, as shown in Figure 7-5.

7.3.2.1 HIC and firm performance

There was clear evidence that acquiring HIC enabled Gamma Ltd to achieve better firm performance. Its expertise in injection moulding and toolmaking facilitated the company to scale up its business successfully by acquiring injection moulding, vacuum forming and tool-making businesses. These acquisitions have enabled the company to move its position from a small to medium company with current sales of over 10 million pounds (approximately 11.5 million euros); this would not have been possible without the knowledge of M&A. In addition, the low turnover rate has helped the company to retain vital skills and achieve better firm performance.

Gamma Ltd always ensures the company hires persons with a good knowledge and the right skills. The company has done so through its recruitment process in which it will look into the experience of the candidates in certain sectors. Embracing people as a key differentiator in the business, Gamma Ltd has taken on a Group Human Resources manager who is responsible for the development of people. The company has also started to use a cloud-based system to manage its HR function and a growing number of recruitment processes. Apart from the screening process, the company provides training to expose the staff to the business; this allows the employees to develop skills that align with the business needs. Gamma Ltd is aware that employees' skills can be enhanced when sending them to large customers' premises. However, this is difficult for an SME to implement due to staffing issues - unlike in large companies, where staffing is not a major issue as the shortage of one or two employees will not affect the whole operation.

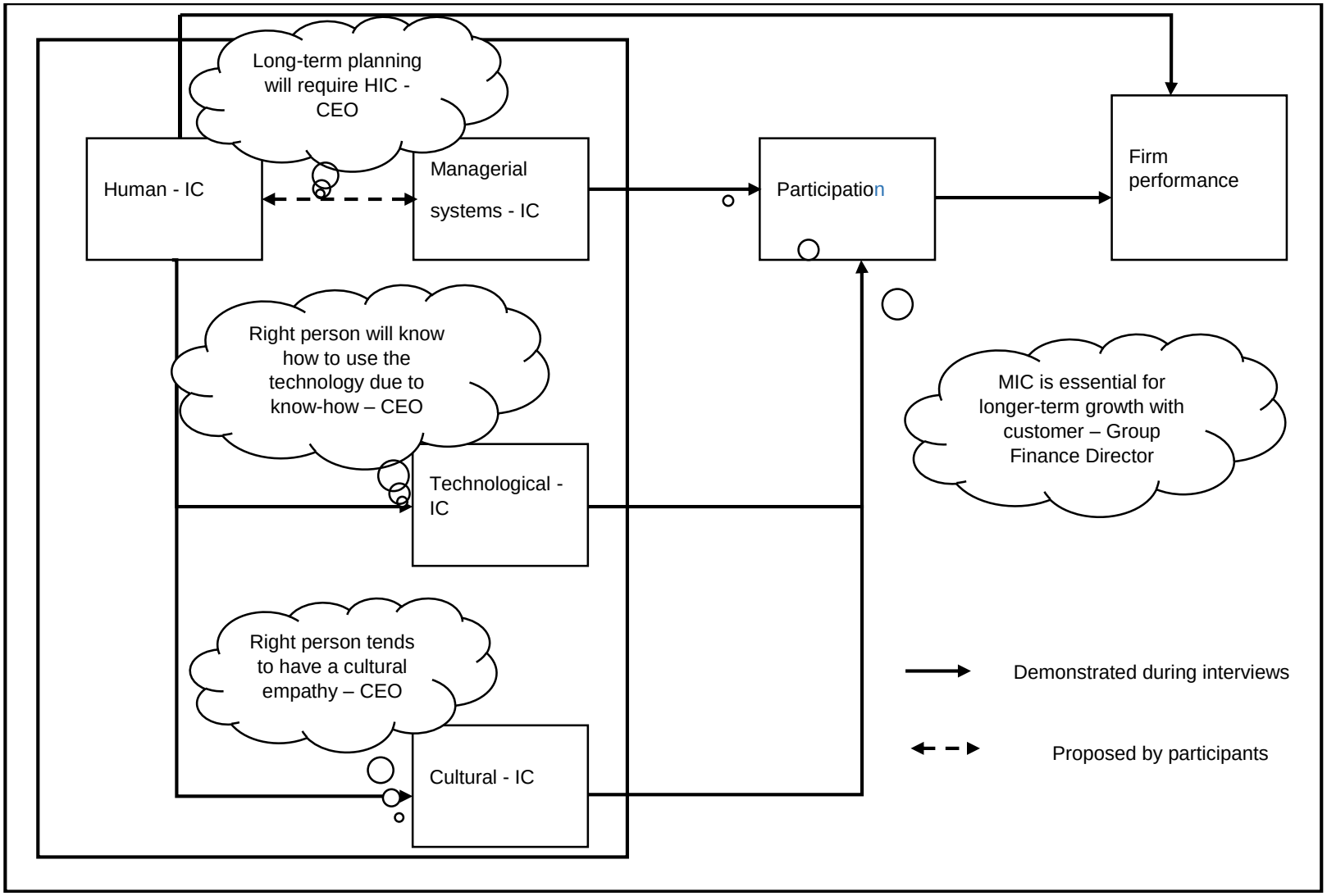


Figure 7-5: Gamma Ltd conceptual framework

Gamma Ltd has successfully offered its skills, knowledge and expertise to large customers. Acquiring certain skills, knowledge and expertise has enabled Gamma Ltd to position itself in front of Tier 1 suppliers and Tier 1 automotive suppliers. With these skills, larger customers do not need to employ people with injection moulding, tool-making and assembly expertise because they can rely on Gamma Ltd. Gamma Ltd always applies HIC in day-to-day activities to resolve customers' queries and issues. This helps the company to maintain its reputation and present its proven capability to large customers. As a result, Gamma Ltd can ensure the company has a good relationship with its customers.

"If you can offer knowledge, skills and expertise to a larger business than yours, that means they don't need to employ that person. They can pick up a phone to one of our technical people and ask a question. You save someone a lot of hassle in business and potentially a lot of money. What we also find in MGN, a global automotive supplier, for some of their product businesses like Motorga, they actually call us up to work out, … I've got this product, … I'm not a plastics injection moulding expert, how do I make it? So, we have a product design engineer down in one of our West Midlands sites who's very experienced in injection moulding and a lot of questions go to him…" (Group finance director).

7.3.2.2 MIC, participation and firm performance

Gamma Ltd agreed that MIC led the company to increase its participation in larger customers' business. There was clear evidence that the effectiveness of Gamma Ltd in MIC has led the company to increase participation. This can be demonstrated when the company expanded its operation from the West Midlands to the East Midlands, and soon into Central Europe. With its latest site in the East Midlands, the company is able to concentrate on point of sale business whilst the other two sites in the West Midlands focus on the automotive industry. The latest site enables the company to take on bigger projects for current and new customers.

In addition, Gamma Ltd spent five years leveraging its MIC before finally gaining orders with an automotive original equipment manufacturer (OEM). Without a full understanding of OEM, long-term plans and aligning with them, Gamma Ltd would not have been able to win a project with MGN, a global automotive supplier in

which after a two-year trading, MGN has become one of Gamma Ltd's largest customers.

Obtaining MIC has enabled Gamma Ltd to not only increase its participation with larger customers but also improved its firm performance. For example, Gamma Ltd improved its sales with MGN from 200 million pounds (approximately 231 million euros) to 500 million pounds (approximately 578 million euros) within two years of business. The company has also successfully increased its sales from 800 thousand pounds (approximately 924 thousand euros) to over 10 million pounds (approximately 11.5 million euros) since it was founded eight years ago. However, according to Gamma Ltd, it would take two to three years for the company to see the improvement on firm performance. Among all the three firm performances, ROI, gross income and net profit, Gamma Ltd tended to value ROI and net profit more than gross income. Gross income can be a danger if business concentrates too much on it. Sometimes in a manufacturing business, gross income is measured based on volume and businesses have to pay for penalty clauses if they are unable to produce the requested volume, which will then erode gross margins.

"Turnover is vanity, profit is sanity but cash is reality. Increasing your revenue ironically takes cash out of the business in the short-term." (Group Finance Director).

Gamma Ltd tended to place emphasis on communication in order to have a successful collaboration with larger customers. The company always has continuous discussions with customers. For example, in the automotive business, Gamma Ltd will undertake two to three tool trials in a month, which involves changing materials or processes for existing products. For new products, Gamma Ltd will do a tool make up or specification, in which the company can add value to the customer. In doing this, Gamma Ltd tries to lead the customers as much as it can to save the business.

Gamma Ltd has long recognised that size matters in a business and so does its reputation. Both participants, i.e. the CEO and Group Finance Director, agreed about the importance of MIC in their business and have placed the highest

emphasis on its current business. Gamma Ltd considered strategic planning with larger customers as critical and relied on these customers to grow its business.

"Customers are being fishy if you are an SME with no brand name." (CEO).

MIC helps Gamma Ltd to protect the company in the longer run. This can be achieved through a long-term planning that the company has with larger customers. However, joint-planning between both companies cannot occur without a good understanding of larger customers in their business. Gamma Ltd tends not to work with those customers who struggle to understand their needs and volume.

"..Probably it (MIC) actually helps us to protect ourselves. What we find is a lot of our customers or some of the customers, we don't have a great deal of understanding of their business, we don't tend to win new work. And that happened to one healthcare customer at the moment; actually, we are just struggling to get time with them, to understand their business and where it's going. As a consequence, the volumes are reducing on that account." (Group Finance Director).

7.3.2.3 HIC as an antecedent to TIC and CIC

Gamma Ltd feels that TIC can only be leveraged with a good foundation of HIC. Without the "right" person who has know-how, Gamma Ltd would not have benefitted from current technological advancement. This happened when Gamma Ltd held back the adoption of a cloud-based electronic data exchange (EDI) in the business because of no expertise in cloud systems. As a result, Gamma Ltd had to talk to Digital Catapult, an advanced digital technology innovation centre in the UK to bring in expertise to the company. Equipped with technical expertise facilitated Gamma Ltd to have a smooth transition from pen and paper to computers and finally to cloud systems. Moreover, Gamma Ltd found it economical in the longer term to invest in internal expertise than subcontract to an external party.

"Some of our automation cells that we've done in the past, we've purchased or someone designed them for us. Due to the cost involved, it is cheaper for us to

develop and build it internally than buy in the knowledge and expertise as previously. Every time it breaks down we can get some of our guys to fix it." (Group Finance Director).

Similarly, Gamma Ltd found it important for the company to have the "right" people in order to leverage its CIC. Gamma Ltd had done this through its recruitment process in which the company hired people from a Tier 1 automotive as these people can understand the Tier 1 culture better and be able to provide culture knowledge to the company. Gamma emphasised that the "right" people tend to be culturally empathic, with the ability to understand feelings of individuals. Gamma Ltd always ensures that all the staff put all the company's principles into practice in everyday business. These principles such as humility, openness, teamwork, and accountability help the company to achieve its aim in gaining customer loyalty.

7.3.2.4 HIC and MIC

Apart from all the above relationships, Gamma Ltd found a linkage between HIC and MIC. On the one hand, it requires the company to have a good relationship with customers through the right knowledge, skills and expertise to develop long-term planning and collaboration. This is because larger customers tend to know future needs better than the SMEs. On the other hand, strategic planning and collaboration are difficult to achieve if SMEs are unable to convince customers when answering their queries.

7.4 Summary

This chapter has presented the results obtained from the qualitative investigations with the purpose of validating the survey findings. Prior to validating the survey findings, the chapter presented some background to the cases. The investigation showed both companies have used SWOT analysis to evaluate their competitive position and applied different types of strategies to grow the business. For the high participation firm, a different growth strategy has been used according to the situation. From the interviews conducted with the SMTs, the results revealed that higher emphasis has been given, by the low participation firm, to HIC to improve its performance. On the other hand, higher weight has been placed by the high

participation firm on MIC. This emphasis enabled the firm to increase participation and subsequently improve the firm performance. The qualitative investigations also showed that HIC acted as an antecedent for TIC and CIC development. As such, it is important for the firm to first develop HIC, as it supports development of other interaction capabilities. In Chapter 8, results of both the quantitative and the qualitative investigations are discussed. The results generally support theoretical predictions and some interesting findings emerge, as embodied in the refined conceptual framework.

8 DISCUSSIONS

8.1 Introduction

This chapter discusses the empirical findings from both quantitative and qualitative points of view. The relationship between each of the four interaction capabilities' (HIC, TIC, MIC and CIC), participation and firm performance, are discussed in Sections 8.2, 8.3, 8.4 and 8.5 respectively. In Section 8.6, the relationships between participation and firm performance are discussed. In each of the sections, quantitative results are first presented, followed by discussions that specify how qualitative results help to enlighten the survey findings. Based on these findings, implications of the study are provided in Section 8.7. Also in Section 8.7, a refined conceptual framework is presented. This framework can guide practitioners on which interaction capabilities to focus on to help them increase their participation with larger customers and improve firm performance. The chapter concludes with a summary in Section 8.8. The structure of the chapter is illustrated in Figure 8-1.

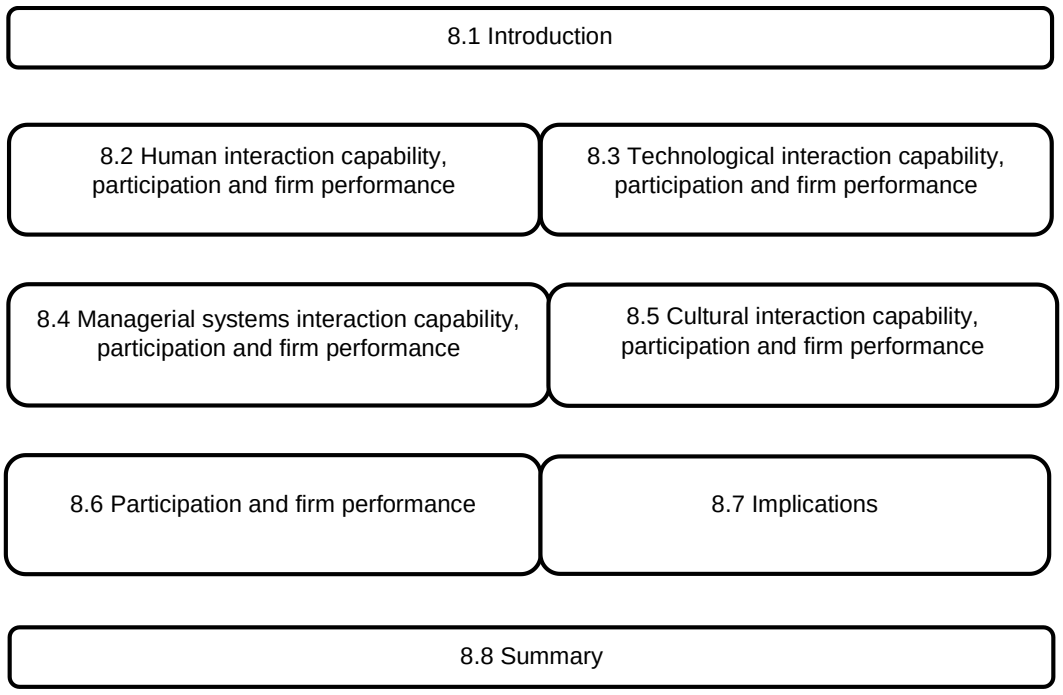


Figure 8-1: Structure of Chapter 8

8.2 Human interaction capability, participation and firm performance

Knowledge generation, sharing, exchange and transfer are firms' activities that are related to knowledge. Such activities that occur within and between organisations may help an organisation to gain competitive advantage and also create value in its relationships (Kogut and Zander, 1992; Grant, 1996a; Dyer and Singh, 1998). In line with this, this thesis has found that HIC is statistically significantly related to firm performance. Similarly, qualitative investigations acknowledged the importance of HIC in improving their firm performance. The interviews revealed that the low participation firm tended to put the highest emphasis on HIC, compared to other interaction capabilities. When both firms were asked to allocate 100 points to each of the capabilities in terms of its importance, two of the top management from the low participation firm placed the highest point on HIC while top management from the high participation firm placed HIC second.

An interview with the CEO from the low participation firm, Delphi Ltd highlighted a strong view for the firm to have HIC in the first place. The view was expressed that HIC was the foundation stone for the firm to sustain its business. Often, customers came to Delphi Ltd because of the expertise that the firm has. The CEO highlighted that the ability to have a conversation with the larger customers' engineers is key for the low participation firm. Through the conversation, Delphi Ltd was able to convince larger customers and secure a project with them. This has then assured the firm's profitability. Similarly, Gamma Ltd, a high-participation firm always ensured that HIC was applied in day-to-day activities by resolving larger customers' queries and concerns in order to maintain a good reputation. HIC could be viewed as a practical aspect of capability in dealing with daily operations (Johnsen and Tseng, 2010; Cui and Hertz, 2011). As such, it is critical, especially for firms at the early stage of industry life cycle, as acquiring HIC will help firms to improve their firm performance.

Both low and high participation firms had developed their HIC in various ways. For the low participation firm, HIC was developed when both firms were involved in joint project developments. In the project, the low participation firm had engaged its personnel with those of larger customers where both companies shared the test

results and allowed new areas of knowledge to be created. This supports previous research that suggests combining the expertise of both parties has enabled some suppliers to make some major developments and innovations (Johnsen and Ford, 2006; Johnsen and Tseng, 2010).

In another situation, the low participation firm sent its engineer to larger customers' premises to fix issues related to the coating process. This led to good relationships between the engineer of the low participation firm and the larger customer's engineer which has endured over many years. In addition, the low participation firm used technical Conferences as a platform to exchange knowledge and skills with potential larger customers. The ability to present own knowledge, skills and expertise would attract potential larger customers to come to the low participation firms to seek solutions. The knowledge gained from the Conferences was then shared internally as part of the internal growth development.

As part of the HIC, the development of internal knowledge, skills and expertise were seen as crucial for the firms to improve their business performance. The interviews with the top management of the high participation firm revealed that knowledge activity, such as providing internal training to the staff, is important to sustain relationships with the customers. In achieving this, the high participation firm exposed the staff to the business to develop their skills as set by the firm. Although the high participation firm had limited opportunity to send its people away to large businesses because of limited numbers of staff, the high participation firm addressed this issue by hiring people who know how big companies think. In the interview, the high participation firm stated that it would prefer to hire people from automotive companies. The CEO viewed automotive people as high quality, innovative and effective at cost management. The CEO also has faith that a good management team would attract more business and customers to the firm. This was evidenced when the firm's expertise in the injection moulding and toolmaking business enabled the firm to acquire other businesses and led the firm to grow from a small to a medium enterprise. This study supports the results of Calantone *et al.* (2002), who argued that learning orientations, which are a part of internal organisational activity, enable the generation of resources and skills, thus improving market share and overall performance.

Although previous studies have shown the positive effect of HIC on different forms of participation (Ngugi *et al.*, 2010; Jean *et al.*, 2018), the findings showed that HIC had an insignificant relationship with participation. Thus, H_1 was rejected. The interview with the micro-firm suggested that the firm was more interested in improving the firm performance than increasing participation in the larger customers' SCs. This relates to the development of MIC which was considered to be expensive to the low participation firm. The low participation firm expressed a strong view that the firm did not want to have 80% volume tied up with one customer as this could be harmful in the future. In addition, this thesis found that no mediator existed between HIC and firm performance. Thus, H_{6a} was also rejected.

The study found that SMEs can improve performance without a mediator, such as participation. As such, SMEs need to be aware of the importance of upgrading the knowledge of their employees through learning or training as knowledge creation is done by individuals not the organisation. This is because knowledge is not similar to other resources, such as machines or land (Nonaka and Takeuchi, 1995). Knowledge is the one of the most strategically important resources that can differentiate one firm from another.

Development of HIC not only allows SMEs to generate and share knowledge with larger customers but, importantly, it may influence the development of MIC. Strategic knowledge that is developed through relationships will allow SMEs to undertake strategic decision making and planning (Wu, 2008). Interviews with the senior executives in low and high participation firms suggested that both HIC and MIC are interrelated. Suppliers can have all the knowledge, skills and expertise in place but might not be able to sell to the market, as they do not know the future demand of the customers. By having strategic collaboration and planning with larger customers, suppliers are able to acquire certain types of knowledge, skills and expertise that meet larger customers' expectations.

8.3 Technological interaction capability, participation and firm performance

This study hypothesised that TIC could directly influence SMEs to increase participation in larger customers' SCs. Previous studies have shown that technological capabilities acquired by firms enable them to enhance market and product developments (Tracey, Vonderembse and Lim, 1999; McEvily *et al.*, 2004; Lin *et al.*, 2006; Gronum *et al.*, 2012). However, this thesis did not find support for TIC influencing participation. Hence, H_2 was rejected. In addition, it was argued that the positive correlation between TIC and participation could indirectly lead to better firm performance. These arguments were supported by several studies that have shown how firms' technological capability can help them to grow and enhance their firm performance (Bharadwaj, 2000; Lee, Lee and Pennings, 2001; Terziovski, 2010; Kim *et al.*, 2011). Surprisingly, the thesis did not find that participation mediated the relationship between TIC and firm performance. As a result, H_{6b} is rejected. Additionally, this study found an insignificant relationship between TIC and firm performance.

The qualitative investigations revealed that HIC is a prerequisite for SMEs to acquire TIC. The interview responses from the low participation firm revealed that the firm would not be able to undertake technological co-development with large customers unless HIC was in place. Often, there was a three-way agreement between the low participation firm, larger customers and universities, to co-develop a solution. HIC allowed the low participation firm to use its knowledge, skills and expertise to co-develop technology and customise it to suit larger customers' wishes. In order to have technology co-development, a good IP rights was required by the low participation firm. The low participation firm tended to walk away from larger customers if unfavourable IP rights was provided. From the interviews with the low participation firm, the firm viewed TIC as important and easy to develop due to the strong engineering skill base that the firm has. In addition, joint projects with larger customers opened the low participation firm's eyes to customers' expectations.

The same view was expressed by SMTs in the high participation firm. As higher emphasis was placed on MIC than on HIC, TIC development was seen as difficult

to the high participation firm. Interviews with the SMTs from the high participation firm pointed out that the firm had to hold back some of the larger customers' requests because of a lack of no expertise. The high participation firm stated that learning was rather limited and often developed based on what larger customers asked the firm to do. This excessive customisation by larger customers could make the TIC become limited and appear unsuited to different expectations of potential new customers (Johnsen and Ford, 2006). This situation happened due to the limited human interaction that the high participation firm has with its larger customers.

From the interviews with SMTs from the two companies, it was clear that the ability of an SME to open up to technological innovation would be non-value adding without first developing an HIC. This is because technology capability comprises compilations of knowledge that are translated through products and processes (Leonard-Barton, 1992). Therefore, for SMEs to acquire TIC, they may need to have a strong base of knowledge co-created with those of larger customers. A strong base of knowledge can serve as an asset in the process learning of SMEs that occurs during joint projects. Parallel to the above arguments, a work by Lee, Trauth and Farwell (1995) indicated that information systems (IS) jobs required multi-dimensions of knowledge/skills.

8.4 Managerial systems interaction capability, participation and firm performance

Hypothesis H_3 examined whether MIC was positively associated with participation. The thesis found a positive, significant relationship between MIC and participation. Hence, H_3 was supported. This finding was in support of Brinckmann *et al.* (2010) who stated that business planning increased the growth of firms. The outcome of business planning between suppliers and customers can be seen in terms of written business plans, goals and budgets.

The results from the case studies also support this finding. Both companies agreed that MIC could enable them to grow their business with larger customers in terms of product, market or diversification. In contrast to HIC, the highest emphasis was placed on MIC by the high participation supplier. Both SMTs from the high

participation firm placed 60 or more points for the MIC when they were asked to divide 100 points into the four interaction capabilities in terms of their importance. In the search for explanations, the interviews highlighted that MIC was crucial for the business to grow. SMTs from the high participation firm claimed that customers know the future needs better than they do. Long-term planning and collaboration with larger customers made the high participation firm fully aware of larger customers' future needs.

From the interviews it was revealed that the high participation firm had spent five years on leveraging its MIC in order to finally gain orders with an automotive OEM. The high participation firm had successfully done this through an understanding of the OEM's long-term plans as well as aligning with the OEM's structure. By developing MIC, the high participation firm had managed to attract a new larger customer.

In doing so, the high participation firm also targeted the "right" decision makers of larger customers to understand what they want and their needs for the future. This allowed the high participation firm to demonstrate what they could deliver by sharing its business plans with the customers. In a similar vein, Terziovski (2010) stated that formal structure is important for SMEs to innovate, which then leads to better growth of the firms in terms of success in new products launched, faster speed to market and improved product innovation. Terziovski's study also claimed that formal systems and procedures lead to better clarity, commitment and organisational effectiveness of the employees.

In drawing the business plans, the high participation firm tended to be flexible to larger customers' requirements to avoid larger customers leaving to join other suppliers. This was also supported by the low participation firm, in that larger customers would shift to a different supplier if SMEs did not follow their requirements unless those SMEs have a unique selling point. Bilateral planning between SMEs and larger customers showed the involvement of SMEs' managers with premeditated activities in promoting collaborative supplier-customer relationships (Ngugi *et al.*, 2010).

Although the low participation firm could not always align with larger customers' managerial systems, it was evident that it had slowly developed MIC.

For the low participation firm, the interaction between the firm and its larger customers tended to be a short-term plan rather than long-term. This is due to the nature of the business in which the low participation firm operates on an order-to-order basis rather than ongoing relationships based on volumes. In this type of relationship, bilateral planning and collaboration only happen during the project that involves R&D planning and ends after the project is completed. Within three months after the project has ended, the low participation firm would contact the customers again to forge collaborative relationships. Here, the low participation firm tended to obtain an initial batch of the project and would not hear anything from the larger customers until they needed a replacement of the initial batch or there was an NPD. By aligning to larger customers' processes, the low participation firm grew its business through offering intermediate services.

However, the low participation firm stated that the firm could not always align with larger customers' managerial systems due to the huge investment that would be involved in developing MIC. It involved the time consumed by the low participation firm to align its managerial systems with the larger customers' systems. The CEO of the low participation firm pointed out that larger customers always push SMEs down to the lower tier of the SC because they want the small suppliers to follow their processes. The smaller firms, such as the low participation firm, could not afford to follow all processes imposed by the larger customers as the low participation firm only has very limited resources in terms of financial skills and labour. As a result, the low participation firm tended to walk away from the larger customers, or advocate to comply with larger customers' processes, but would not want to maintain the relationship. Advocacy of suppliers was also evidenced in other studies, in that suppliers will make what their larger customers ask them to do, but will not develop new products for the larger customers. This suppliers' disappointment arose because some of their larger customers considered them to be "not-fit-for-purpose", especially for inclusion in supplier-customer relationship planning (Johnsen and Ford, 2006).

Contrary to expectations, this thesis did not find a significant correlation between MIC and performance. The findings showed that participation mediated the relationship between MIC and firm performance. Therefore, H_{6c} was supported. The qualitative findings confirmed that by having strategic planning and collaboration with larger customers, SMEs could increase their participation and this led to better firm performance. This was seen in the high participation firm in which expanding geographical markets increased its annual turnover. This is in line with the literature that bilateral planning is valuable in assuring continuous supply, improving sales and maintaining a healthy cash flow for both suppliers and larger customers (Ngugi et al., 2010). The senior executives that were interviewed pointed out that MIC acted as a protection in the longer term.

In summary, it can be concluded that findings from both the survey and the case studies suggest that MIC increases SMEs' participation and that the increase in participation improves firm performance.

8.5 Cultural interaction capability, participation and firm performance

Culture is inherited and learned by individuals through a number of interactions with various cultural clusters forming an individual's cultural schemas, which are further applied during relationships with other parties (Ivanova-Gongne, 2015). Extant literature has shown that CIC influences SMEs to increase product development and find new customers (Ngugi et al., 2010; Talay and Dean, 2012). Nonetheless, this thesis found an insignificant relationship between CIC and participation; thus, H_4 was rejected. As a result, this study found support for the research by Terziovski (2010) stating that innovative culture had an insignificant relationship with participation.

This thesis, then, argued that the ability of an SME to be tolerant and learn its larger customers' culture could lead to better firm performance. The result of this study indicated that CIC was not found to cause better firm performance. In exploring the unexplained relationship between CIC and firm performance, it also did not find support for participation acting as a mediator between CIC and firm performance; therefore, H_{6d} was rejected. Although previous literature highlighted the importance

of integrating cultures when diversifying into other countries or segmenting into other markets, this thesis showed no significant relationship between them.

Even though all the coefficients' paths were insignificant, they were all positive – as expected. Qualitative investigations suggest that CIC could only be developed when HIC was in place. Interviews with the senior executives revealed that CIC requires human understanding and this could lead to cultural empathy embedded in their staff. The high participation firm tackled this issue through hiring in; the firm tended to hire people from the customer base as these people have culture knowledge and are able to interact and understand larger customers' culture better.

The low participation firm, on the other hand, does not usually have problems as the firm has HIC in place. Engineering knowledge and the firm expertise were seen as the dominant culture for the low participation firm in the early stage of the project. However, CIC became a problem at the later stage when issues emerged during the project. Interviewees pointed out that larger customers' values were not aligned with their values; larger customers tried to use their power and became abusive to small suppliers. As a consequence, the low participation firm often stepped back if there was no good cultural fit and simply improved the firm performance through its HIC. In contrast, Johnsen and Ford (2006) highlighted that the smallest suppliers, who are often strongly independent and proud of their own culture and values, were able to maintain good positions in the relationships.

Therefore, this thesis suggests the importance for SMEs to ensure their employees have the necessary skills and expertise, as these will support the development of CIC.

8.6 Participation and firm performance

The earlier review of the literature on the relationship between participation that was represented by product, market and diversification and firm performance found mixed results for the relationships between them. Consistent with $H_{5,}$ this study showed a positive relationship between participation and firm performance. This study supports previous research that participation through product, market

or diversification improves firm performance (Zahra *et al.*, 2000; Qian *et al.*, 2010; Gronum *et al.*, 2012). Thus, the study did not support research by Barbero Navarro *et al.* (2012) and Mishina *et al.* (2004) who argued that geographical expansion did not enhance firm performance and sales growth. Additionally, this study rejected a finding by Mishina *et al.* (2004) that product expansion is negatively related to the rate of short-term sales growth. The inconsistent results from the literature might be explained by the fact that participation was examined more broadly, rather than individual constructs of product, market or diversification. This is also due to the time taken to see the improvement of firm performance resulting from the participation. This is confirmed from the interviews in that the high participation firm took two to three years to see performance improvement after increasing participation.

Qualitative data also indicated that an increase in participation helped the firms to improve firm performance. It was evident from the interviews that both firms improved their firm performance through increased participation. For the low participation firm, participation in terms of product development and market segmentation was seen as crucial in sustaining the firm's profitability. Interviewees from the low participation firm pointed out that the firm always finds different market sectors to improve firm performance, as reliance on one sector would have a detrimental effect when the sector has gone out of business. For the high participation firm, acquisition was seen as the main driving factor for the firm to improve its annual turnover. Through acquisitions, the high participation firm managed to extend its business to new geographical areas and expand its product range, which provided greater flexibility to its customers. The high participation firm has also improved its offerings by diversifying its business from manufacturing as a service to product.

8.7 Implications

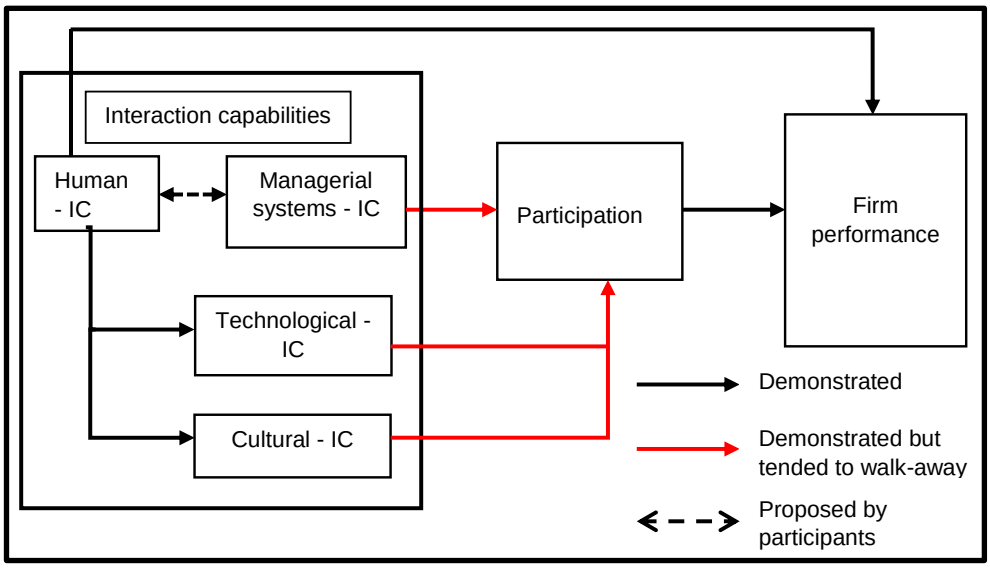


Figure 8-2: Revised conceptual framework

This study advances the interaction capabilities literature and provides new insights by revealing which interaction capabilities have enabled SMEs to increase participation in larger customers' SCs. From the case studies, it was realised that interaction capabilities are crucial in driving SMEs to grow their share with larger customers as well as improve their firm performance. Interviewees from the high and low participation firms indicated that perfect SMEs will need to have all interaction capabilities; however, they also indicated that it is costly for SMEs to acquire all of them.

As a result, a refined interaction capability framework, as shown in Figure 8-2, may assist SMEs to make better and more informed decisions about which interaction capabilities should be the focus, if they cannot afford to acquire all of them. First, SMEs may need to prioritise on developing HIC. The results suggest SMEs should have HIC in place as it significantly improves their firm's performance. HIC does not only improve the firm performance, but it also supports development of TIC and CIC. By having required knowledge, skills and expertise in place, it would be easier for SMEs to use this knowledge and resources to undertake technological co-development and turn their customers' requirements into product or service offerings. Similarly, the findings indicate that the "right" people influence the cultural

development between SMEs and their larger customers; without the “right” people, collaborative relationships cannot be fostered.

Second, SMEs may need to consider investing in MIC. The empirical findings have shown that participation can be increased through SMEs planning and collaborating strategically with larger customers. Subsequently, SMEs who increased their participation in larger customers’ SCs could improve their firm performance. Although both SMEs agreed that MIC leads the firms to grow business with larger customers, the low participation firm, on the other hand, tended to step away if it felt that it could not afford to align its systems with those of larger customers.

8.8 Summary

This chapter proposed a set of interaction capabilities that have an important direction for SMEs to increase their participation in larger customers’ SCs as well as driving superior firm performance. The empirical evidence has implications, in which values that the business upholds, influence the development of interaction capabilities between SMEs and their larger customers. The case studies’ findings have shown that the values they uphold may present positive and negative impacts to their relationships. In particular, the results have shown that the low participation firm tended to walk away from any situation in which the firm felt larger customers were being abusive towards them.

This fact could be influenced by the size of the firm. For the smaller suppliers, such as the high participation firm, aligning with larger customers’ processes is important for future relationships in which it ensures that the firm will become more established in the market. The high participation firm is aware that as the firm grows bigger the brand speaks for itself. In contrast, the low participation firm has scarce resources that limit its movement. Unlike the high participation firm, the low participation firm might not be able to comply with all the requirements asked by the larger customers. The size differences might not necessarily be indicative of the low participation firm’s limitations. Indeed, the low participation firm has flexibility in running its business as the main concern of the firm is to be profitable,

without the need to comply with all the bureaucratic processes imposed by the larger customers.

9 CONCLUSION

9.1 Introduction

This chapter brings the study to a conclusion. The study has examined the role of interaction capabilities in increasing SMEs' participation in larger customers' SCs which leads to better firm performance. This was achieved by testing the relationships of interaction capabilities, participation and firm performance variables. Further, the survey results were validated through case studies. This chapter concludes the research by reviewing the overarching research question in Section 9.2. This section summarises the findings of the research. Subsequently, this chapter evaluates the research by discussing the contributions of the research in Section 9.3 and its limitations in Section 9.4. In the same section, some further work is suggested on what can be done following the findings before the chapter is brought to a close with a chapter summary (Section 9.5). Figure 9-1 presents the structure of the chapter.

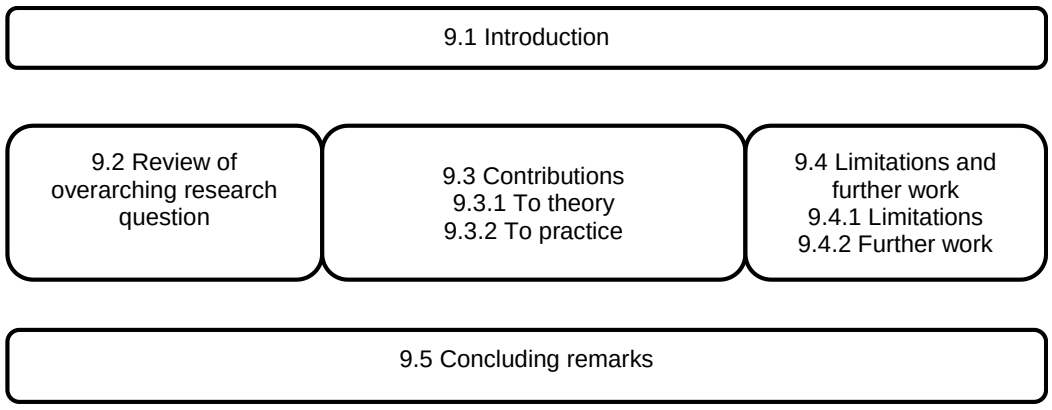


Figure 9-1: Structure of Chapter 9

9.2 Review of overarching research question

SMEs play a crucial role in both developed and emerging economies in terms of businesses, employment and turnover. For instance, in the UK, SMEs account for 99.9% of businesses (Department for Business Energy & Industrial Strategy, 2018). Although SMEs make a significant contribution to the economy, they still appear in the lower tier of larger businesses' chains. The research also highlighted

that SMEs in manufacturing had difficulty in finding customers and retaining skilled staff/experienced managers (European Commission, 2017). Here, larger businesses play an important role in stimulating the growth of SMEs by assisting in upskilling SMEs. Larger businesses, however, can also hamper SMEs' growth by cutting the costs down, late payments and imposing processes and additional costs (Jamieson *et al.*, 2012). As such, it is essential for SMEs to have effective interaction with larger customers as it influences the growth of the firms.

Prior research on interaction capabilities have shown the capabilities, represented as HIC, TIC, MIC and CIC, as integral for SMEs to better manage their relationships with larger customers. Realising the importance of SMEs to grow their business with larger customers, this study aimed to explore the role of interaction capabilities in increasing SMEs' participation in larger customers' SCs. In order to meet the purpose of this study, a three-phase methodological framework was employed: a) instrument development, b) survey questionnaire and c) case studies. As current studies on interaction capabilities are purely qualitative and no pre-existing scales exist for them, the study has developed a scale for interaction capabilities, illustrated in Figure 3-4. The robust measures of interaction capabilities developed in this study can be useful for SMEs when they evaluate their current level of interaction capabilities and their influence on their relationships with their larger customers. This scale can also help them to identify the strengths and weaknesses of their interaction capabilities.

Once the scale of interaction capabilities was ready, the empirical work of the survey questionnaire was conducted and assessed through CFA. By employing the survey questionnaire, research findings could be extrapolated into other situations as a larger population was involved. Further, case studies were employed to validate the survey results. The findings from this research concur with prior research on interaction capabilities in which these capabilities were critical for SMEs to interact effectively with their larger customers. Specifically, the results from the survey questionnaire and the case studies demonstrated the importance for SMEs to combine and exchange knowledge, skills and expertise with larger customers as this significantly improved their firm performance. The development of HIC was not only critical for firm performance but it also seemed to have an influence on how TIC and CIC were developed. Through HIC, smooth

technological innovation and cultural fit between SMEs and their larger customers could be achieved. However, the qualitative investigations suggested that the low participation firm preferred to walk away if larger customers were abusive to the small suppliers such as imposing unfavourable IP rights. Moreover, the study showed the significant role of MIC in increasing SMEs' participation in larger customers' SCs. The study suggested SMEs should invest in the capability that requires strategic planning and collaboration with larger customers as it not only supports SMEs to grow business in conjunction with larger customers but it also improves the firm performance. Here, the study highlighted the important role of participation in mediating the relationships between MIC and firm performance. In addition, the study pointed out that some SMEs, such as the low participation firm tended not to plan and collaborate strategically with larger customers due to high investments being required. As such, the study suggested SMEs should acquire HIC if they have limited resources, such as financial, as developing knowledge, skills and expertise with larger customers increases their firm performance and supports development of TIC and CIC. These findings have addressed the Overarching Research Question, by examining the role of interaction capabilities in increasing SMEs' participation and improving their firm performance.

9.3 Contributions

The previous section reviewed whether the overarching research question was met, by summarising the main points of the research findings. In reviewing the overarching research question, the study identified some contributions that it makes to theory and practice. As such, Section 9.3.1 explores the contributions the study makes in the body of interaction capabilities knowledge, whereas Section 9.3.2 discusses the contributions of the study from a practical point of view.

9.3.1 To theory

This study has made a number of theoretical contributions to understanding the role of interaction capabilities in enabling SMEs' participation in larger customers' SCs, subsequently leading to improving firm performance.

Following the precedent of past studies (Min and Mentzer, 2004; Li *et al.*, 2005; Swafford *et al.*, 2006; Menor and Roth, 2007; Cao and Zhang, 2011; Ambulkar *et al.*, 2015; Brandon-Jones, 2017), the first contribution of this study is the development of an interaction capabilities scale. The study, having developed an interaction capabilities scale, then operationalised and rigorously validated the measurement scale for data collection in further studies. The study referred to the scale development process in SCC studies (Cao, 2007; Cao and Zhang, 2011, 2013) along with early research on scale development in OM (SaraphI et al., 1989; Sakakibara *et al.*, 1993; Ahire *et al.*, 1996) and other studies in the 2000s (Li *et al.*, 2005; Zhao *et al.*, 2011; Ambulkar *et al.*, 2015). The scale has been tested through rigorous statistical analyses including Q-sort, pretest with the academics, pilot-testing with the respondents through EFA, and empirical testing through CFA. Through robust measures, the underlying structure of interaction capabilities for HIC (three items), TIC (four items), MIC (seven items) and CIC (five items) was established. The scale development process shed new light within an SC context due to scarce research on scale construction in this area. Therefore, this research can be used as a guideline for SC researchers to develop a scale in the future. Researchers can also use the scale developed in this study for further studies of interaction capabilities.

Second, the research represents the most comprehensive empirical examination of interaction capabilities by employing a mixed-method approach. In the second phase of data collection, a quantitative approach was employed to test the relationships between interaction capabilities, participation and firm performance. To the author's best knowledge, this study is the first effort to use large-scale empirical work in understanding the role of interaction capabilities. Responding to calls for further research by Johnsen and Ford (2006), this study validated the results of earlier research through the alternative methodological approach of survey research, as prior studies on interaction capabilities mainly centred around case studies. By employing large-scale empirical work, more generalisation of research findings could be made as multiple industries that were not included in prior research could be covered, such as food and drink, pharmaceuticals, aerospace and chemicals. Subsequently, this research validated the survey findings through empirical data collection of case studies. The use of case studies provided a deeper understanding of the findings and this triangulation effort with the companies shows that there was no concern with the data. In addition, the mixed method approach employed in this study contributes to the number of mixed methods designs in SCM, as these are rarely used in SCM (Golicic and Davis, 2012).

Third, the research developed a conceptual framework to explore the role of interaction capabilities in enabling SMEs' participation in larger customers' SCs, which then led to better firm performance. The conceptual model was built based on the different literature on manufacturing, capability, growth and business performance. By blending all the literature, a full picture of the role of interaction capabilities to increase SME participation in larger customers' SCs has been captured. The framework has provided a foundation for future empirical testing that examines the relationships from either the larger customer's perspective or both sides of the relationship.

Fourth, the study contributes to the body of buyer-supplier relationships knowledge in OM. This study explored capabilities that are required by suppliers to interact effectively with larger customers; specifically, by identifying the types of interaction capabilities that were significant for SMEs to increase their participation and improve their firm performance. Unlike prior research that favoured LEs, this study

shifted the focus to SMEs and the benefits that they gained from developing interaction capabilities. The research provides insights to the buyer-supplier relationships domain by investigating capability from relationship-specific properties, rather than firm-specific.

9.3.2 To practice

The findings of this study have a number of practical implications. The study has highlighted the importance of SMEs to develop interaction capabilities. Qualitative investigations revealed that a perfect SME should acquire all the interaction capabilities as it allows them to capture and exploit opportunities within customer relationships. As such, it is crucial for SMEs to assess their interaction capability. Practitioners can use the validated scale of interaction capabilities as a tool to measure their current state of interaction capabilities which will then help them to determine whether further development is needed. In addition, the insights from the qualitative investigations provide ways for companies to develop each of the interaction capabilities.

The research offers scope for SMEs to use the revised framework to make better and more informed decisions about which interaction capability to prioritise, as not all SMEs may be able to acquire all the interaction capabilities. The framework will guide them to focus on the right interaction capabilities to enable them to grow their businesses. In particular, the owners or top management of the firms should be actively involved in strategic planning and collaboration with their larger customers as this is the starting point for SMEs to increase their participation with the larger customers which will then improve the SMEs' performance. For small suppliers, such as low participation firms who do not have the resources to undertake strategic planning and collaboration, they can focus on developing and combining knowledge, skills and expertise with larger customers. Developing this HIC will help SMEs to achieve better firm performance and subsequently support the development of other interaction capabilities, i.e. TIC and CIC.

9.4 Limitations and further work

As with all studies, this research also has some limitations. Section 9.4.1 identifies them and in Section 9.4.2, some recommendations are offered to counteract them.

9.4.1 Limitations

Although the study has made contributions to theory and practice, there were also some limitations recognised. Firstly, the potential issue of common method bias may arise due to common source or rater effects. Common source or rater refers "to any artifactual covariance between predictor and criterion variable produced by the fact that the respondent providing the measure of these variables is the same" (Podsakoff *et al.*, 2003, p.882). In this study, the same sources of SMEs were used to answer the predictor and criterion variables. Thus, some of the measures in the model, especially for the criterion, might be biased and not represent the actual activities between both parties. There are two reasons for this.

First is the difficulty in obtaining objective data, as SMEs usually keep the information away from the public domain. Second, the study is bound by time constraints, making it difficult to obtain financial data from the SMEs' customers. The study faced some difficulties in obtaining respondents from SMEs because, in most cases, the owner was responsible for answering the questionnaire and most of the owners were too busy. Much time and effort was spent in gaining a higher response rate. The author realised that a telephone call was the best method to reach the respondents and much time was spent in phoning the respondents. Follow-up calls were made a few times to the same respondents as some of them did not return calls in time. As more time was spent to obtain data from SMEs, the author decided to collect data from only one source, SMEs. This study recognised the issue and therefore, mitigation took place by conducting a common method bias remedy, Harman's single factor. The test confirmed that common method bias was not present. In addition, employing the multiple-case studies method mitigated some of the survey limitations.

The time and financial constraints faced by the study led to the next limitation, small sample size. As OM studies do not have a large sample size, this study did not manage to collect a sufficiently large sample size for the pilot study to keep for the

main empirical work. Consequently, the EFA test could not be run for the entire constructs, instead individual tests were performed for each interaction capabilities construct. Due to the limited sample size, the study only managed to gather data from 181 respondents. Although it is quite common to have fewer than 200 respondents in OM research, this limits the analysis that could be done by the study. The study explored other options to obtain more responses, such as hiring Qualtrics, to gain access to the respondents; however, the price was prohibitive.

The third limitation was the low number of items represented by some of the interaction capabilities constructs. The survey instrument contained multiple items for each interaction capability construct that it attempted to measure. Many items were dropped throughout the process, from instrument development to main empirical work, especially for HIC. The goal in the scale development was to have a minimum of three items per construct but ideally, four items would have been better. The HIC construct had a minimum of three items, TIC had four constructs and the other two had more than four.

The fourth limitation is related to the cross-sectional design adopted in this study. Currently, the research assumes that the relationships between variables are static in nature. Considering that interaction capabilities are developed gradually over the years, the survey research is limited in its capacity to reflect the development of interaction capabilities on participation and firm performance through time. Further work, therefore, can be validated through longitudinal analysis which would provide important insights on the interrelationships among interaction capabilities, participation and firm performance at different periods of time.

The limitation of this research can also be seen in the scope. This study is limited to only one industry and one country: the HVM industry in the UK. Although the study only involved the manufacturing industry, the study contained multiple industry sectors that were not covered in the prior research. Therefore, generalisation of the findings could be made in various industry sectors. The results, however, may not apply to other countries if SMEs' structures are not similar to those in the UK. In the qualitative part of the study, the use of only two case studies could mean bias in the data. Nonetheless, the two case studies provided more external validity, such as generalisability, than the single study

(Leonard-Barton, 1990). In addition, the two case studies represented polar types which illustrated one case of a high participation firm and one low participation case.

9.4.2 Further work

While this study contains its own limitations, it does provide a starting point for further work. As this study was restricted to one side of relationships, it therefore offer scope for future study to examine the framework from either the larger customer's perspective or both sides of the relationship. More insights will be gained by collecting data from a supplier-buyer dyad rather than just from SMEs. A comparative study between SMEs and LEs will provide another perspective to the body of knowledge in this area.

Future research should also explore the framework in different contexts, by examining the role of interaction capabilities in increasing SMEs' participation framework in other industries. One option for future research would be examining the framework in the construction industry as this industry accounts for the largest industrial sector in terms of SME numbers. Another option is to investigate the framework in services, such as wholesale and retail trade, as this industrial sector accounts for the highest share in terms of SME employment and turnover in 2018 (Department for Business Energy & Industrial Strategy, 2018). Examining the framework across different industries and their current level of interaction capabilities would help recognise any industry-specific bias towards or against the interaction capabilities. A comparative study could also be employed outside the UK to other areas, such as Asia, to compare and contrast the findings.

9.5 Concluding remarks

This chapter has reviewed the main goal of the study. The purpose of this study – to examine the role of interaction capabilities in increasing SMEs' participation – was achieved through several measures, instrument development and a mixed method approach. In spite of the study's limitations in several areas, the work offers valuable theoretical and practical insights, along with some recommendations for future work. Of immense value to the author is not only the contributions but also the research skills acquired in the whole PhD process – specifically, the opportunity to develop skills in scale construction. Although it required much time and effort, the skills will be invaluable in the future, especially as not all researchers in the OSCM area have the opportunity to develop a scale at the early stage of their academic career. In addition, employing a mixed method approach gave the author the opportunity to extend her current knowledge on the survey method by exploring different statistical analyses and simultaneously acquiring new skills in conducting case studies. It is hoped that the findings provide useful insights to both academics and practitioners and that future work can be embarked on by using them.

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APPENDICES

Appendix C, D, E and F are presented in both landscape and portrait to aid inspection and clarity across 65 pages.

Appendix A **Measurement items entering each round of Q-sort**

A.1 Human interaction capability

Measurement Items	First Round	Second Round	Third Round	Instrument Pretest	Fourth Round
We work with larger customers to build new or common areas of expertise	Keep	Keep	***Reword*** *We are able to work with larger customers to build new or common areas of expertise*	Keep	***Reword*** *We effectively work with larger customers to build new or common areas of expertise*
We develop internal skills and knowledge through exchange with larger customers during joint projects	Keep	Keep	***Reword*** *We are effective in developing internal skills and knowledge during joint projects with larger customers*	Keep	***Reword*** *We effectively develop internal skills and knowledge during joint projects with larger customers*
We combine knowledge with larger customers to develop new products	Keep	Keep	***Reword*** *We effectively combine knowledge with larger customers to develop new products*	Keep	Keep

We attend external training courses to develop the required skills and knowledge	Keep	Keep	***Reword*** *We attend the right external training courses to develop the required skills and knowledge*	Keep	Drop
We visit our larger customers to learn from them	Keep	Keep	***Reword*** *We learn a lot from visit to our larger customers*	Keep	Keep
We identify training needs through audits by larger customers	Keep	Keep	***Reword*** *We use the audits by larger customers to identify training needs*	Keep	Drop
We form cross-functional, cross-hierarchical teams to facilitate knowledge exchange with larger customers	Keep	Keep	***Reword*** *We are good at forming cross-functional, cross-hierarchical teams to facilitate knowledge exchange with larger customers*	Keep	Keep
We have cross-fertilisation of expertise with larger customers	Keep	***Reword*** *We combine our expertise with the expertise of our larger customers*	***Reword*** *We effectively combine our expertise with the expertise of our larger customers*	Keep	Keep

We send our employees to have internships at larger customers' premises	Keep	Keep	Drop		
We visit our larger customers' premises to learn and give suggestions	Keep	Drop			
We have close dialogue with larger customers	Keep	Move to managerial systems			

A.2 Technological interaction capability

Measurement Items	First Round	Second Round	Third Round	Experts	Fourth Round
We develop new ways to integrate our technical systems with those of the customers	Keep	***Reword*** *We develop new ways to integrate our technical systems with those of larger customers*	***Reword*** *We are good at developing new ways to integrate our technical systems with those of larger customers*	Keep	***Reword*** *We effectively develop new ways to integrate our technological systems with those of larger customers*
We customise and integrate technical systems with larger customers	Keep	Keep	***Reword*** *We can effectively customise and integrate our technical systems with those of larger customers*	Keep	***Reword*** *We effectively customise our technological systems to those of larger customers*
We have limited production systems integration with larger customers	Keep	Keep	***Reword*** *We find it difficult to integrate production systems with larger customers*	Keep	Drop
We coordinate with external partners to improve the technical aspects of our larger customers' offerings	Keep	Keep	***Reword*** *We are able to coordinate with external partners to improve the technical aspects of our larger customers' offerings*	Keep	Drop

Our technological knowledge allows us to turn larger customer requirements into innovative ideas	Keep	Keep	Keep	***Reword*** *We are effective in turning our larger customers' requirements into innovative ideas*	Drop
We develop our systems/technology according to larger customers' wishes	Keep	Keep	***Reword*** *We are effective in developing our systems/technology according to larger customers' wishes*	Keep	Keep
We have joint R&D activities with larger customers to develop new technology	Keep	Keep	***Reword*** *We effectively develop new technology through joint R&D activities with larger customers*	Keep	Keep
Through exchange activities with larger customers we ensure that we have the level of manufacturing competence that matches their needs	Keep	Drop			

We achieve fast product commercialisation through integrated technical systems with larger customers	Keep	Keep	Keep	Keep	Drop
We achieve fast technological innovation through larger customer interaction	Keep	Keep	Keep	Keep	Keep
We upgrade IT systems to adapt to new customers	Keep	Keep	***Reword*** *We effectively upgrade IT systems to new customers*	Keep	Keep
We can flexibly adapt our technologies to new customers to provide customised service offerings	Keep	Keep	Keep	Keep	Keep
We make quick changes and adaptations to our production lines to satisfy our larger customers' requirements	Keep	***Reword*** *We can quickly adapt our production lines to satisfy our larger customers' requirements*	Keep	Keep	Keep

A.3 Managerial systems interaction capability

Measurement Items	First Round	Second Round	Third Round	Experts	Fourth Round
We have unstructured and unclear strategic direction to deal with larger customers	Keep	Keep	Drop		
We advocate an independent approach to planning as opposed to a joint one with our larger customers	Keep	***Reword*** *We plan independently, as opposed to jointly with our large customers*	***Reword*** *We are effective in planning jointly with our large customers*	Keep	Keep
We have standard relationships with larger customers due to lack of inter-organisational skills	Keep	***Reword*** *We adopt the same approach in all our larger customer relationships*	Drop		
Our company's strategic direction does not depend on larger customers	Keep	Keep	Drop		
We have regular face to face communication with larger customers	Keep	Keep	***Reword*** *We have effective face to face communication with larger customers*	Drop	
We focus on close working relationships with larger customers	Keep	Keep	***Reword*** *We have close working relationships with larger customers*	Drop	

We insist on the importance of face to face communication to maintain good relationships with larger customers	Keep	Keep	Drop		
We adopt different relationship management approaches to deal with different customers	Keep	Keep	***Reword*** We are able to adopt different relationship management approaches to deal with different customers	Drop	
We find it difficult to achieve synergies with larger customers in building managerial capability	Keep	***Reword*** *We find it difficult to achieve collaboration with larger customers*	***Reword*** *We find it difficult to successfully collaborate with larger customers*	***Reword*** *We find it difficult to collaborate with larger customers*	Drop
We develop business plans in collaboration with larger customers	Keep	***Reword*** *We develop business plans jointly with larger customers*	***Reword*** *We successfully develop business plans jointly with larger customers*	***Reword*** *We successfully develop business plans in collaboration with larger customers*	***Reword*** *We effectively develop business plans in collaborations with larger customers*

We have a flat/de-layered organisational structure to enable important decisions to be taken quickly in response to larger customer requests	Keep	Keep	Keep	Drop	
We possess diverse customer relationship management experience	Keep	***Reword*** *We have experience in managing diverse customer relationships*	***Reword*** *We are experienced in managing diverse customer relationships*	Drop	
We have close dialogue with larger customers		New item	Keep	Drop	
With our larger customers we solve joint problems effectively				New item	Keep
We effectively include larger customers in our goal-setting activities				New item	Keep
Our advice and counsel is sought by our larger customers				New item	Drop
Our suggestions are encouraged by larger customers				New item	Drop
We are effective in aligning our strategy with the strategy of our larger customers				New item	Keep

We are good at understanding larger customers' strategic plans				New item	Keep
We can effectively incorporate customer requirements into our plans, policies and objectives				New item	***Reword*** *We effectively incorporate customer requirements into our plans, policies and objectives*
We can effectively help our larger customers in their planning activities				New item	***Reword*** *We effectively help our larger customers in their planning activities*
We can effectively respond to our larger customers' planning activities				New item	***Reword*** *We can effectively respond to our larger customers' planning activities*

A.4 Cultural interaction capability

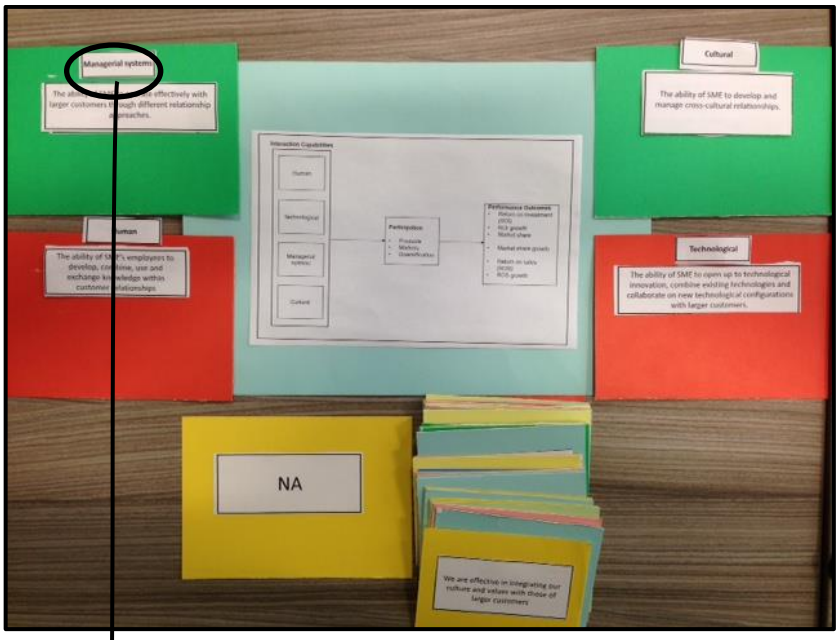
Measurement Items	First Round	Second Round	Third Round	Experts	Fourth Round
We learn and accept larger customers' values and norms	Keep	***Reword*** *We have learnt to accept larger customers' values and norms*	Keep	Keep	Drop
We have limited experience of cross-cultural relations	Keep	Keep	***Reword*** *We have much experience of cross-cultural relations*	Keep	Drop
We are always tolerant of a larger customer's culture	Keep	Keep	Keep	Keep	***Reword*** *We effectively tolerate the culture of our larger customers*
We are open to developing common working culture and values with larger customers	Keep	Keep	***Reword*** *We are effective in developing common working culture and values with larger customers*	Keep	Keep
We relish the opportunity of cross-cultural learning	Keep	Keep	Keep	Keep	Drop

We relish the opportunity to acquire international management experience and skills	Keep	Keep	Keep	Keep	Drop
We adapt to larger customers' values and culture quickly and globally	Keep	Keep	Keep	Keep	***Reword*** *We effectively and quickly adapt to larger customers' values and culture*
We treat larger customers as friends irrespective of their culture	Keep	Keep	Keep	Keep	***Reword*** *We are good at treat larger customers as friends irrespective of their culture*
We put our larger customers first at all times	Keep	Drop			
We keep ourselves up-to-date with changing requirements of larger customers and the markets they operate in	Keep	Drop			

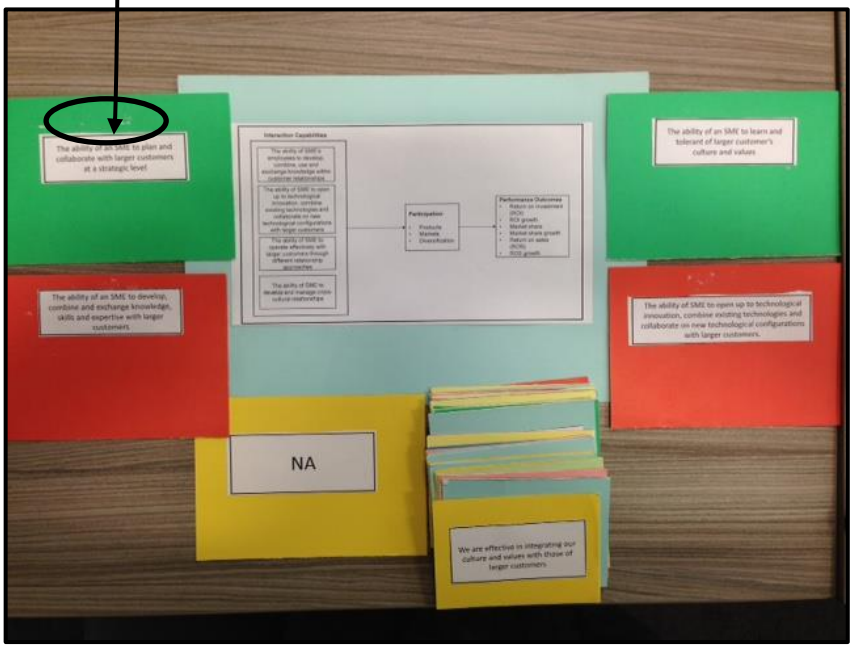
We find it difficult to change our culture and values even if a larger customer requires it	Keep	Keep	Keep	Keep	Keep
We integrate our culture and values with those of larger customers	Keep	Keep	***Reword*** *We are effective in integrating our culture and values with those of larger customers*	Keep	Keep

Appendix B **Structured interviews and Q-sort changes**

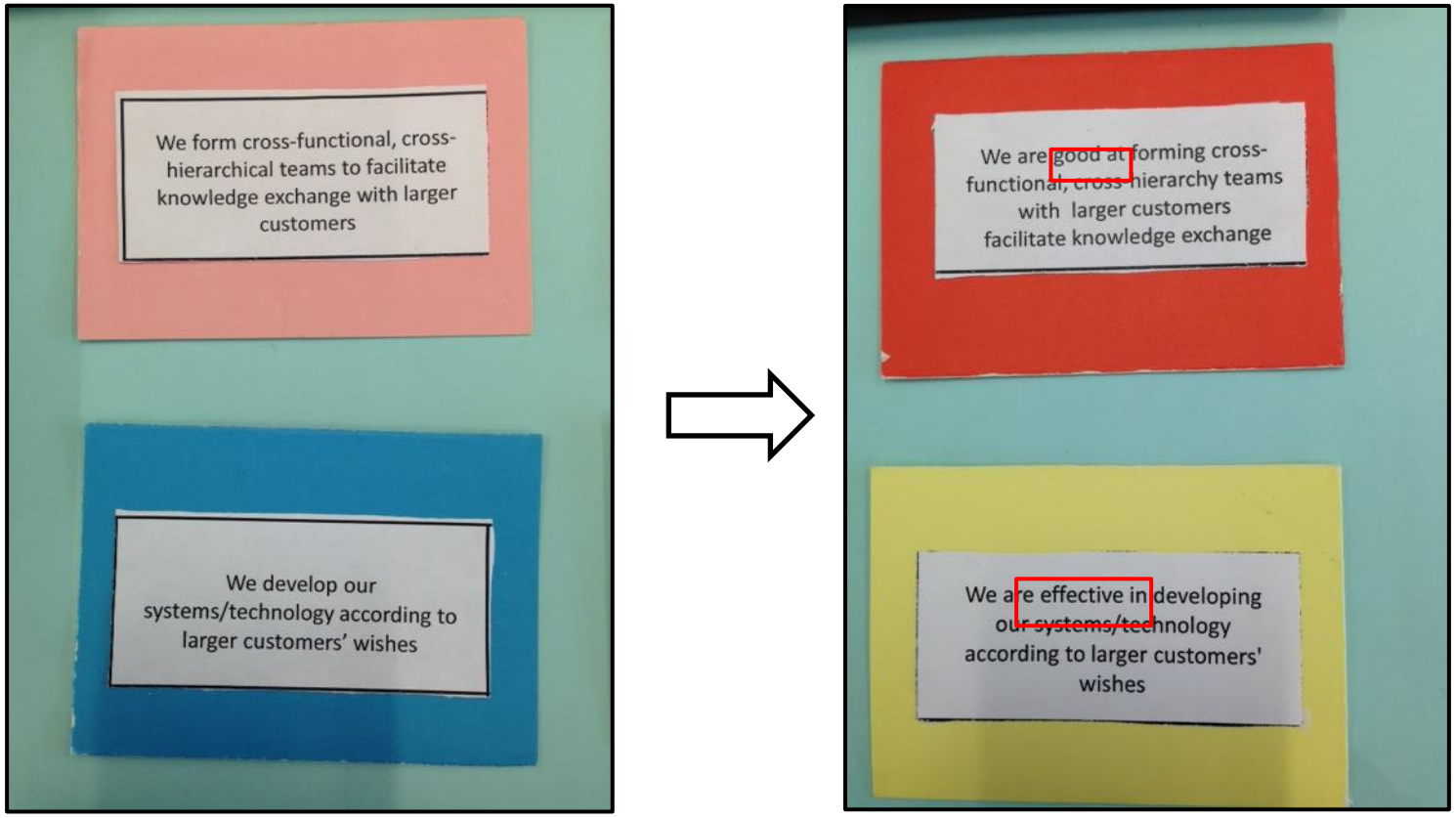
B.1 Round 1 and Round 2 with the name of the constructs, HIC, TIC, MIC and CIC



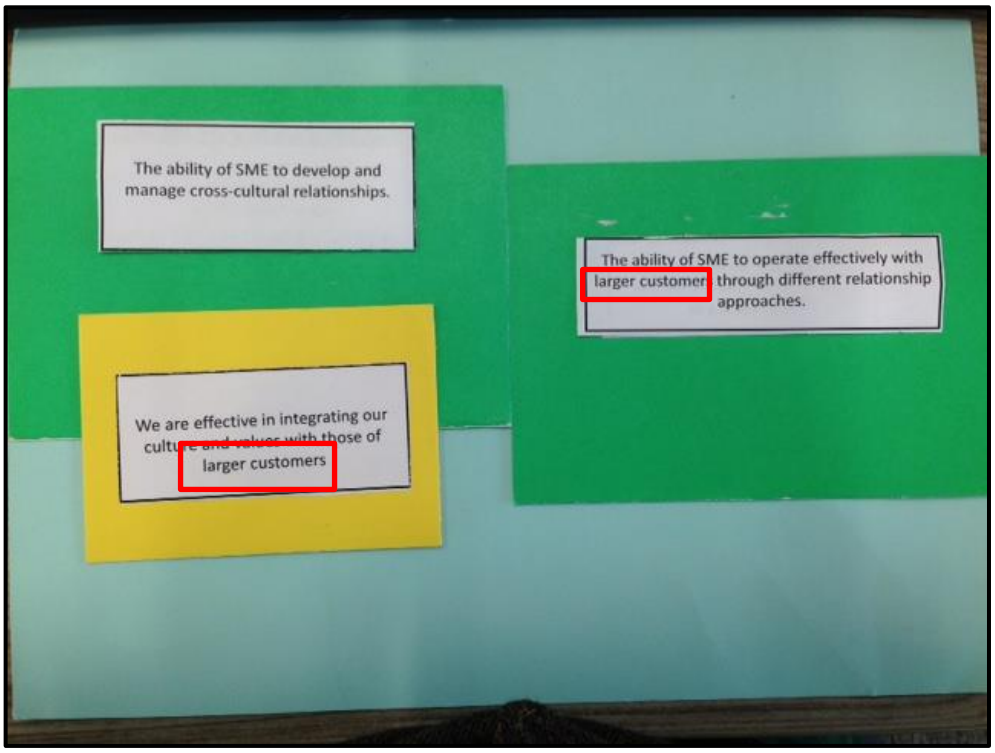
B.2 Round 3 and 4 without the name of the constructs



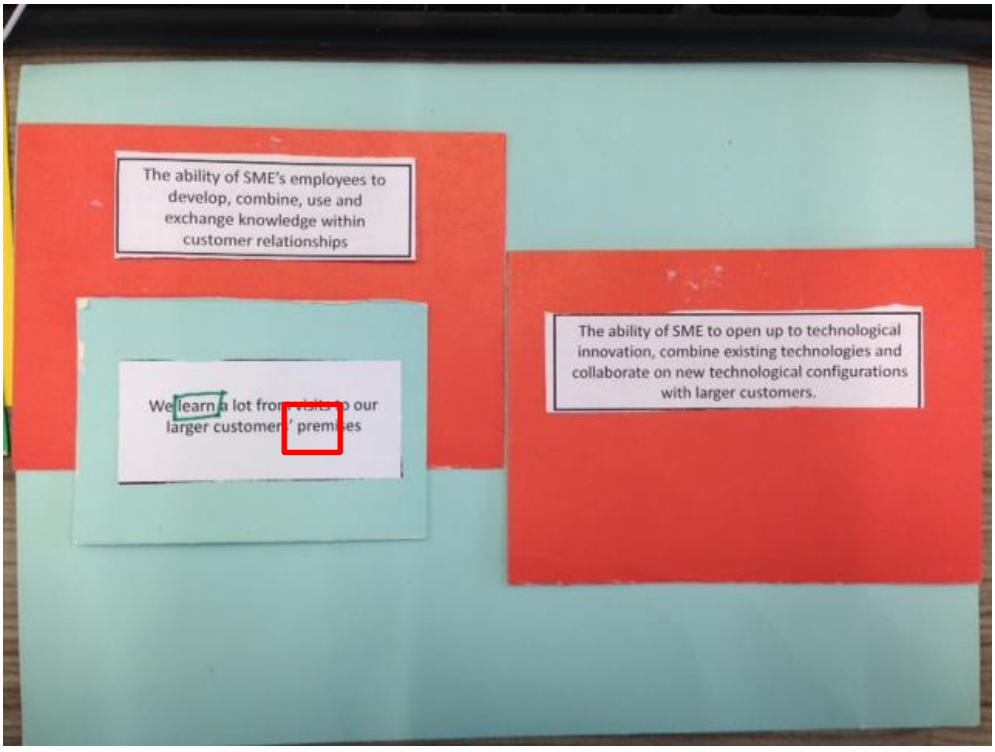
B.3 Changes from round 2 to 3



B.4 Item did not correspond to the definition



B.5 Ambiguous triggering word



Appendix C **Pretest instrument**

You are invited to take part in a project involving the development of an instrument to measure the interaction capabilities of Small Medium Enterprises (SMEs). Previous research in Industrial Marketing Management (IMM) has proposed a set of interaction capabilities that SMEs must have in their relationships with larger customers. Yet, to date there are no measures for these capabilities.

This project is undertaken for educational purposes and will contribute towards a Doctorate Degree in Engineering. The aim of the research study is to examine the relationship between interaction capabilities and SMEs' participation in High Value Manufacturing (HVM) Global Value Chains (GVCs). At part of the analysis, we would like to test whether these also lead to better SMEs performance in terms of investment, turnover and profits. Within the context of this study, interaction capabilities have been defined as the abilities of an SME to interact effectively with larger customers and include **human, technological, managerial systems** as well as **cultural.** The definition of each capability/construct is provided in the next sections. SME performance and participation are measured using existing scales/measures, so your help is needed only with respect to the newly developed interaction capability scales.

We would truly appreciate if you review the items we have generated, and rate them by indicating whether we should keep, drop or modify according to the following criteria:

a) how well they reflect their respective interaction capabilities
b) how well they correspond to the definitions
c) how intelligible they are, and
d) how well they cover their respective construct

The exercise should not take you more than 15 minutes to complete.

We thank you for your response.

Zakiah Syamra' Suhaimi (PhD Candidate)
E-mail: z.s.b.suhaimi@warwick.ac.uk
Prof Janet Godsell & Dr Antony Karatzas (Supervisors)

Below you will find a set of definitions and a list of statements. Please use the text entry to modify the definition and rate the items accordingly by selecting keep, drop or modify.

A Human Interaction Capability

Definition: The ability of an SME to develop, combine and exchange knowledge, skills and expertise with larger customers.

Q1 Please indicate whether to keep, drop or modify item.

	Keep	Drop	Modify
We are able to work with larger customers to build new or common areas of expertise	O	O	O

Please suggest modification.

Q2 Please indicate whether to keep, drop or modify item.

	Keep	Drop	Modify
We are effective in developing internal skills and knowledge during joint projects with larger customers	O	O	O

Please suggest modification.

Q3 Please indicate whether to keep, drop or modify item.

	Keep	Drop	Modify
We effectively combine knowledge with larger customers to develop new products	O	O	O

Please suggest modification.

Q4 Please indicate whether to keep, drop or modify item.

	Keep	Drop	Modify
We attend the right external training courses to develop the required skills and knowledge	O	O	O

Please suggest modification.

_____

Q5 Please indicate whether to keep, drop or modify item.

	Keep	Drop	Modify
We learn a lot from visits to our larger customers	O	O	O

Please suggest modification.

_____

Q6 Please indicate whether to keep, drop or modify item.

	Keep	Drop	Modify
We use the audits by larger customers to identify our training needs	O	O	O

Please suggest modification.

_____

Q7 Please indicate whether to keep, drop or modify item.

	Keep	Drop	Modify
We are good at forming cross-functional, cross-hierarchical teams with larger customers to facilitate knowledge exchange	O	O	O

Please suggest modification.

Q8 Please indicate whether to keep, drop or modify item.

	Keep	Drop	Modify
We effectively combine our expertise with the expertise of our larger customers	O	O	O

Please suggest modification.

If there are items that we have not managed to cover that you would wish to see on human construct, please write them below.

B Technological Interaction Capability

Definition: The ability of an SME to open up to technological innovation, combine existing technologies and collaborate on new technological configurations with larger customers

Q1 Please indicate whether to keep, drop or modify items.

	Keep	Drop	Modify
We are good at developing new ways to integrate our technical systems with those of larger customers	O	O	O

Please suggest modification.

Q2 Please indicate whether to keep, drop or modify items.

	Keep	Drop	Modify
We can effectively customise and integrate our technical systems with those of larger customers	O	O	O

Please suggest modification.

_____

Q3 Please indicate whether to keep, drop or modify items.

	Keep	Drop	Modify
We find it difficult to integrate production systems with larger customers	O	O	O

Please suggest modification.

_____

Q4 Please indicate whether to keep, drop or modify items.

	Keep	Drop	Modify
We are able to coordinate with external partners to improve the technical aspects of our larger customers' offerings	O	O	O

Please suggest modification.

_____

Q5 Please indicate whether to keep, drop or modify items.

	Keep	Drop	Modify
We are effective in turning our larger customers' requirements into innovative ideas	O	O	O

Please suggest modification.

_____

Q6 Please indicate whether to keep, drop or modify items.

	Keep	Drop	Modify
We are effective in developing our systems/technology according to larger customers' wishes	O	O	O

Please suggest modification.

_____

Q7 Please indicate whether to keep, drop or modify items.

	Keep	Drop	Modify
We effectively develop new technology through joint R&D activities with larger customers	O	O	O

Please suggest modification.

_____

Q8 Please indicate whether to keep, drop or modify items.

	Keep	Drop	Modify
We achieve fast product commercialisation through integrated technical systems with larger customers	O	O	O

Please suggest modification.

Q9 Please indicate whether to keep, drop or modify items.

	Keep	Drop	Modify
We achieve fast technological innovation through larger customer interaction	O	O	O

Please suggest modification.

Q10 Please indicate whether to keep, drop or modify items.

	Keep	Drop	Modify
We effectively upgrade IT systems to adapt to new customers	O	O	O

Please suggest modification.

Q11 Please indicate whether to keep, drop or modify items.

	Keep	Drop	Modify
We can flexibly adapt our technologies to new customers to provide customised service offerings	O	O	O

Please suggest modification.

Q12 Please indicate whether to keep, drop or modify items.

	Keep	Drop	Modify
We can quickly adapt our production lines to satisfy our larger customers' requirements	O	O	O

Please suggest modification.

_____

If there are items that we have not managed to cover that you would wish to see on technological construct, please write them below.

_____

C Managerial systems Interaction Capability

Definition: The ability of an SME to strategically plan and collaborate with larger customers.

_____

Q1 Please indicate whether to keep, drop or modify items.

	Keep	Drop	Modify
We are effective in planning jointly with our larger customers	O	O	O

Please suggest modification.

_____

Q2 Please indicate whether to keep, drop or modify items.

	Keep	Drop	Modify
We successfully develop business plans in collaboration with larger customers	O	O	O

Please suggest modification.

_____

Q3 Please indicate whether to keep, drop or modify items.

	Keep	Drop	Modify
We find it difficult to collaborate with larger customers	O	O	O

Please suggest modification.

_____

Q4 Please indicate whether to keep, drop or modify items.

	Keep	Drop	Modify
With our larger customers we solve joint problems effectively	O	O	O

Please suggest modification.

_____

Q5 Please indicate whether to keep, drop or modify items.

	Keep	Drop	Modify
We effectively include larger customers in our goal-setting activities	O	O	O

Please suggest modification.

_____

Q6 Please indicate whether to keep, drop or modify items.

	Keep	Drop	Modify
Our advice and counsel is sought by our larger customers	O	O	O

Please suggest modification.

_____

Q7 Please indicate whether to keep, drop or modify items.

	Keep	Drop	Modify
Our suggestions are encouraged by larger customers	O	O	O

Please suggest modification.

_____

Q8 Please indicate whether to keep, drop or modify items.

	Keep	Drop	Modify
We are effective in aligning our strategy with the strategy of our larger customers	O	O	O

Please suggest modification.

_____

Q9 Please indicate whether to keep, drop or modify items.

	Keep	Drop	Modify
We are good at understanding larger customers' strategic plans	O	O	O

Please suggest modification.

_____

Q10 Please indicate whether to keep, drop or modify items.

	Keep	Drop	Modify
We can effectively incorporate customer requirements into our plans, policies and objectives	O	O	O

Please suggest modification.

_____

Q11 Please indicate whether to keep, drop or modify items.

	Keep	Drop	Modify
We can effectively help our larger customers in their planning activities	O	O	O

Please suggest modification.

_____

Q12 Please indicate whether to keep, drop or modify items.

	Keep	Drop	Modify
We can effectively respond to our larger customers' planning activities.	O	O	O

Please suggest modification.

_____

Q13 If there are items that we have not managed to cover that you would wish to see on managerial systems construct, please write them below.

_____

D Cultural Interaction Capability

Definition: The ability of an SME to learn and be tolerant of larger customers' culture and values.

Q1 Please indicate whether to keep, drop or modify items.

	Keep	Drop	Modify
We have learnt to accept larger customers' values and norms	O	O	O

Please suggest modification.

Q2 Please indicate whether to keep, drop or modify items.

	Keep	Drop	Modify
We have much experience of cross-cultural relations	O	O	O

Please suggest modification.

Q3 Please indicate whether to keep, drop or modify items.

	Keep	Drop	Modify
We are always tolerant of a larger customer's culture	O	O	O

Please suggest modification.

Q4 Please indicate whether to keep, drop or modify items.

	Keep	Drop	Modify
We are effective in developing common working culture and values with larger customers	O	O	O

Please suggest modification.

_____

Q5 Please indicate whether to keep, drop or modify items.

	Keep	Drop	Modify
We relish the opportunity of cross-cultural learning	O	O	O

Please suggest modification.

_____

Q6 Please indicate whether to keep, drop or modify items.

	Keep	Drop	Modify
We relish the opportunity to acquire international management experience and skills	O	O	O

Please suggest modification.

_____

Q7 Please indicate whether to keep, drop or modify items.

	Keep	Drop	Modify
We adapt to larger customers' values and culture quickly and globally	O	O	O

Please suggest modification.

Q8 Please indicate whether to keep, drop or modify items.

	Keep	Drop	Modify
We treat larger customers as friends irrespective of their culture	O	O	O

Please suggest modification.

Q9 Please indicate whether to keep, drop or modify items.

	Keep	Drop	Modify
We find it difficult to change our culture and values even if a larger customer requires it	O	O	O

Please suggest modification.

Q10 Please indicate whether to keep, drop or modify items.

	Keep	Drop	Modify
We are effective in integrating our culture and values with those of larger customers	O	O	O

Please suggest modification.

Q11 If there are items that we have not managed to cover that you would wish to see on cultural construct, please write them below.

Thank you for your response.

Appendix D **Pilot survey questionnaire**

Thank you for taking part in this study. The project is led by Professor Janet Godsell from Warwick Manufacturing Group (WMG), University of Warwick.

It takes 10 minutes to complete the questionnaire.

The aim of this study is to examine the degree of SMEs' participation in global value chains (GVCs). The results of this study could provide some recommendations for UK manufacturing SMEs to grow their global footprint.

Please do not hesitate to contact me via email if you have any queries.

Professor Janet Godsell
WMG, University of Warwick
E-mail: J.Godsell@warwick.ac.uk

Information Leaflet

Participation in this study is entirely voluntary and you can withdraw at any time without giving a reason, by closing the web browser, but it will not be possible to withdraw data once submitted as all responses are anonymous. By completing the survey, participants are consenting for the data to be used in this research. The information provided by respondents will be stored for 3 years on university computer and my laptop which is password protected. The information will be anonymous and will not be used for other purposes than this research. The results will not be reported on a company level, but summaries of the whole data will be provided. The anonymised data will be available to the researchers that will have a joint-publication with me only.

This study is covered by the University of Warwick's insurance and indemnity cover. Any complaint about the way you have been dealt with during the study or any possible harm you might have suffered will be addressed. Please address your complaint to the person below, who is a senior University of Warwick official entirely independent of this study:

Head of Research Governance
Research & Impact Services
University House
University of Warwick
Coventry
CV4 8UW
Tel: 024 76 522746
Email: researchgovernance@warwick.ac.uk

To thank you for your time, we would like to provide you with a copy of the final research report, and include you in a draw for a free ticket for the 2017 Global Supply Chain Debate 2017 (GSCD) hosted by WMG, University of Warwick in November.
Please let us know if you are interested:

Do you want to receive the final report of this study?

O Yes (5)

O No (6)

Do you want to join the draw to get a free ticket of the Global Supply Chain Debate 2017 (GSCD)? (An overview of last year's event can be found here: http://www2.warwick.ac.uk/fac/sci/wmg/research/scip/gscd/).

O Yes (5)

O No (6)

Please provide the full name of your company

_____

Please indicate the number of years since your company was founded,

_____

Please indicate the primary industry in which your company operates

- O Electronics (1)
- O Clothing and footwear (2)
- O Industrial and mechanical equipment (3)
- O Furniture and home furnishing (4)
- O Automotive (5)
- O Capital projects and infrastructure (6)
- O Rubber and plastic products (7)
- O Home appliances (8)
- O Electrical equipment (9)
- O Biomedical equipment (10)
- O Toys (11)
- O Food and beverages (12)
- O Energy, utilities and mining (13)
- O Chemicals (14)
- O Aerospace, defence and security (15)
- O Health and beauty care (16)
- O Basic metals (17)
- O Jewellery (18)
- O Engineering and construction (19)

- O Pharmaceuticals (20)
- O Shipbuilding (21)
- O Textiles (22)
- O Forest, paper and packaging (23)
- O Printing and publishing (24)
- O Coke and refined petroleum products (25)
- O Other (26) _____

Please indicate the number of employees in your company

- O 1 - 9 (1)
- O 10 - 50 (2)
- O 51 - 250 (3)
- O 251 - 500 (4)
- O 501 - 1,000 (5)
- O 1,001 - 5,000 (6)
- O over 5,000 (7)

Please indicate the legal structure of your company

- O Sole trader (1)
- O Ordinary business partnership (2)
- O Limited partnership (3)
- O Limited liability partnership (4)
- O Limited company (5)
- O Unincorporated association (6)

Please indicate the turnover of your company in the last financial year

- O > £500 million (1)
- O £100 million - £500 million (2)
- O £50 million - £100 million (3)
- O £10 million - £50 million (4)
- O £2 million - £10 million (5)
- O < £2 million (6)

Please describe the nature of your 'customers': (tick all that apply)

- ☐ Other organisations or businesses (1)
- ☐ Individual consumers (e.g. the general public) (2)
- ☐ Governments (3)

What type(s) of value chain activities is your firm currently engaged in? (Tick all that apply)

- [ ] Research (1)
- [ ] Design of development of products and services (2)
- [ ] Production (3)
- [ ] Logistics and distribution (4)
- [ ] Sales and marketing (5)
- [ ] After sales services (6)

Please indicate the average percentage of your firm's total expenditure spent on Research and Development (R&D) activities during the last 3 years

_____

Please describe the category that best describes the current geographical markets served by your firm (tick all that apply)

- [ ] Local region (1)
- [ ] United Kingdom (2)
- [ ] Europe (3)
- [ ] Rest of the world (4)

Please indicate the management level of your current position

- O Executive (1)
- O Senior management (2)
- O Middle management (3)
- O Junior management (4)

Please indicate your current job function

- O Accounting/Finance (1)
- O General management/Human Resources (2)
- O Marketing/Sales (3)
- O Production/Manufacturing (4)
- O Planning (5)
- O Purchasing/Procurement (6)
- O Logistics/Distribution (7)
- O Research and Development (8)
- O Legal (9)
- O Supply Chain (10)
- O Other (11) _____

Please indicate how many years have you been working for this company

_____

High Value Manufacturing

Rank your basis of competition in order of preference from 1 (least liked) to 4 (most liked)

_____ Cost (1)
_____ Quality (2)
_____ Flexibility (3)
_____ Responsiveness (4)

How would you define High Value Manufacturing (HVM)?

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree	Do not know
Application of new processes and technologies (1)	O	O	O	O	O	O	O	O
Involvement in traditional, new and emerging industries (2)	O	O	O	O	O	O	O	O
High skilled employees or high level of investment (3)	O	O	O	O	O	O	O	O

Interaction Capability

This section of the questionnaire will ask you some questions about the effectiveness of your firm in a number of areas relating to your interaction with larger business customers. When answering, please think of your 'average' effectiveness across larger customer relationships, and reply as sincerely as possible.

Q1-1 Please rate the effectiveness of your firm in the following activities, relative to your major competitors (1=not effective at all to 7=extremely effective).

	Not effective at all						Extremely effective	Not Applicable
Developing internal skills and knowledge during joint projects with larger customers	O	O	O	O	O	O	O	O
Combining knowledge with larger customers to develop new products	O	O	O	O	O	O	O	O
Gaining knowledge from visits to larger customers	O	O	O	O	O	O	O	O

Forming cross-functional, cross-hierarchical teams with larger customers to facilitate knowledge exchange	O	O	O	O	O	O	O	O
Working with larger customers to build new or common areas of expertise	O	O	O	O	O	O	O	O
Combining our expertise with the expertise of larger customers	O	O	O	O	O	O	O	O

Q1-2 Please rate the effectiveness of your firm in the following activities, relative to your major competitors (1=not effective at all to 7=extremely effective).

	Not effective at all						Extremely effective	Not Applicable
Developing new ways to integrate our technological systems with those of larger customers	O	O	O	O	O	O	O	O
Customising our technological systems to those of larger customers	O	O	O	O	O	O	O	O
Developing our systems/technology according to larger customers' wishes	O	O	O	O	O	O	O	O
Developing new technology through joint R&D activities with larger customers	O	O	O	O	O	O	O	O

Achieving technological innovation through larger customer interaction	O	O	O	O	O	O	O	O
Upgrading our IT systems to adapt to those of larger customers	O	O	O	O	O	O	O	O
Adapting our technologies to new large customers to provide customised service offerings	O	O	O	O	O	O	O	O
Adapting our production lines to satisfy larger customers' requirements	O	O	O	O	O	O	O	O

Q1-3 Please rate the effectiveness of your firm in the following activities, relative to your major competitors (1=not effective at all to 7=extremely effective).

	Not effective at all						Extremely effective	Not Applicable
Planning jointly with large customers	O	O	O	O	O	O	O	O
Developing business plans in collaboration with larger customers	O	O	O	O	O	O	O	O
Solving joint problems with larger customers	O	O	O	O	O	O	O	O
Including larger customers in our goal-setting activities	O	O	O	O	O	O	O	O

Aligning our strategy with the strategy of larger customers	O	O	O	O	O	O	O	O
Understanding larger customers' strategic plans	O	O	O	O	O	O	O	O
Incorporating larger customer requirements into our plans, policies and objectives	O	O	O	O	O	O	O	O
Assisting larger customers in their planning activities	O	O	O	O	O	O	O	O
Responding to larger customers' planning activities	O	O	O	O	O	O	O	O

Q1-4 Please rate the effectiveness of your firm in the following activities, relative to your major competitors (1=not effective at all to 7=extremely effective).

	Not effective at all						Extremely effective	Not Applicable
Tolerating the culture of larger customers	O	O	O	O	O	O	O	O
Developing common working culture and values with larger customers	O	O	O	O	O	O	O	O
Adapting to larger customers' values and culture	O	O	O	O	O	O	O	O
Treating larger customers as friends irrespective of their culture	O	O	O	O	O	O	O	O

Changing our culture and values when a larger customer requires it	O	O	O	O	O	O	O	O
Integrating our culture and values with those of larger customers	O	O	O	O	O	O	O	O

So far, do you have any comments or concerns about the preceding questions? Please express them here

_____

Each of the following items consists of a pair of statements which represent the two extremes regarding the different ways in which businesses may compete.

Q2-1
Please consider each of the following pairs of statements as they relate to your business, relative to your major competitors. Indicate which position on the scale between the two polar extremes best describes the emphasis you have placed on each in establishing your ***current*** competitive position

Providing a narrow range of products	O	O	O	O	O	O	O	Providing a broad range of products
Providing products with narrow usage	O	O	O	O	O	O	O	Providing products with broad usage
Continued new product development	O	O	O	O	O	O	O	Maintaining current products
Serving limited or specific geographical markets	O	O	O	O	O	O	O	Serving broad (global) markets
Selling products to one market segment	O	O	O	O	O	O	O	Selling product to numerous market segments
Small number of customers	O	O	O	O	O	O	O	Large numbers of customers
Single channel of distribution	O	O	O	O	O	O	O	Many channels of distribution

No backward integration towards suppliers and raw materials	O	O	O	O	O	O	O	Extensive backward integration towards suppliers and raw materials
No forward integration toward customers and consumers	O	O	O	O	O	O	O	Extensive forward integration towards customers and consumers
Narrow range of diversification into related businesses	O	O	O	O	O	O	O	Wide range of diversification into related businesses
Narrow range of diversification into unrelated businesses	O	O	O	O	O	O	O	Wide range of diversification into unrelated businesses

Q2-2 Please consider each of the following pairs of statements as they relate to your business, relative to your major competitors. Indicate which position on the scale between the two polar extremes best describes the emphasis you have placed on each in establishing your *future* competitive position.

Providing a narrow range of products	O	O	O	O	O	O	O	Providing a broad range of products
Providing products with narrow usage	O	O	O	O	O	O	O	Providing products with broad usage
Continued new product development	O	O	O	O	O	O	O	Maintaining current products
Serving limited or specific geographical markets	O	O	O	O	O	O	O	Serving broad (global) markets
Selling products to one market segment	O	O	O	O	O	O	O	Selling products to numerous market segments
Small number of customers	O	O	O	O	O	O	O	Large number of customers
Single channel of distribution	O	O	O	O	O	O	O	Many channels of distribution

No backward integration towards suppliers and raw materials	O	O	O	O	O	O	O	Extensive backward integration towards suppliers and raw materials
No forward integration towards customers and consumers	O	O	O	O	O	O	O	Extensive forward integration towards customers and consumers
Narrow range of diversification into related businesses	O	O	O	O	O	O	O	Wide range of diversification into related businesses
Narrow range of diversification into unrelated businesses	O	O	O	O	O	O	O	Wide range of diversification into unrelated businesses

Q2-3 Please indicate the ***expected degree of change*** in the following commercial aspects of your firm in the near future.

	Significant decrease			No change			Significant increase
Range of products offered	O	O	O	O	O	O	O
Extent of product usage	O	O	O	O	O	O	O
New product development	O	O	O	O	O	O	O
Number of geographic markets served	O	O	O	O	O	O	O
Market segments	O	O	O	O	O	O	O
Number of customers	O	O	O	O	O	O	O
Channels of distribution	O	O	O	O	O	O	O
Backward integration	O	O	O	O	O	O	O

Forward integration	O	O	O	O	O	O	O
Diversification into related businesses	O	O	O	O	O	O	O
Diversification into unrelated businesses	O	O	O	O	O	O	O

So far, do you have any comments or concerns about the preceding questions? Please express them here

_____

Performance Outcomes

Q3-1 Please evaluate your performance relative to major competitors for each of the following six measures.

	Worst in industry						Best in industry
Return on investment (ROI)	O	O	O	O	O	O	O
ROI growth	O	O	O	O	O	O	O
Gross income	O	O	O	O	O	O	O
Income growth	O	O	O	O	O	O	O
Net profit	O	O	O	O	O	O	O
Net profit growth	O	O	O	O	O	O	O

Would you like to participate in a second round of this survey?

- O Yes (4)
- O No (5)

Last question!
In the next stage of this work, we would like to 'match' your company with a larger customer of yours. If you would like to help us, please provide the name of one of your major business customers.
You could also write down the email address of the main contact.

Appendix E **Web-based questionnaire**

Thank you for taking part in this study. The project is led by Professor Janet Godsell from Warwick Manufacturing Group (WMG), University of Warwick.

It takes 10 minutes to complete the questionnaire.

The aim of this study is to examine the degree of SMEs' participation in global value chains (GVCs). The results of this study could provide some recommendations for UK manufacturing SMEs to grow their global footprint.

Please do not hesitate to contact me via email if you have any queries.

Professor Janet Godsell
WMG, University of Warwick
E-mail: J.Godsell@warwick.ac.uk

Information Leaflet

Participation in this study is entirely voluntary and you can withdraw at any time without giving a reason, by closing the web browser, but it will not be possible to withdraw data once submitted as all responses are anonymous. By completing the survey, participants are consenting for the data to be used in this research. The information provided by respondents will be stored for 3 years on university computer and my laptop which is password protected. The information will be anonymous and will not be used for other purposes than this research. The results will not be reported on a company level, but summaries of the whole data will be provided. The anonymised data will be available to the researchers that will have a joint-publication with me only.

This study is covered by the University of Warwick's insurance and indemnity cover. Any complaint about the way you have been dealt with during the study or any possible harm you might have suffered will be addressed. Please address your complaint to the person below, who is a senior University of Warwick official entirely independent of this study:

Head of Research Governance
Research and Impact Services
University House
University of Warwick
Coventry
CV4 8UW
Tel: 024 76 522746
Email: researchgovernance@warwick.ac.uk

To thank you for your time, we would like to provide you with a copy of the final research report, and include you in a draw for a free ticket for the 2017 Global Supply Chain Debate 2017 (GSCD) hosted by WMG, University of Warwick in November.

Please let us know if you are interested:

Do you want to receive the final report of this study?

O Yes

O No

Do you want to join the draw to get a free ticket of the Global Supply Chain Debate 2017 (GSCD)? (An overview of last year's event can be found here: http://www2.warwick.ac.uk/fac/sci/wmg/research/scip/gscd/).

O Yes

O No

Please indicate the primary industry in which your company operates

- O Electronics
- O Clothing and footwear
- O Industrial and mechanical equipment
- O Furniture and home furnishing
- O Automotive
- O Capital projects and infrastructure
- O Rubber and plastic products
- O Home appliances
- O Electrical equipment
- O Biomedical equipment
- O Toys
- O Food and beverages
- O Energy, utilities and mining
- O Chemicals
- O Aerospace, defence and security
- O Health and beauty care
- O Basic metals
- O Jewellery
- O Engineering and construction

- O Pharmaceuticals
- O Shipbuilding
- O Textiles
- O Forest, paper and packaging
- O Printing and publishing
- O Coke and refined petroleum products
- O Other _____

Please indicate the number of employees in your company

- O 1 - 9
- O 10 - 50
- O 51 - 250
- O 251 - 500
- O 501 - 1,000
- O 1,001 - 5,000
- O over 5,000

Please indicate the legal structure of your company

- O Sole trader
- O Ordinary business partnership
- O Limited partnership
- O Limited liability partnership
- O Limited company
- O Unincorporated association

Please indicate the turnover of your company in the last financial year

- O > £500 million
- O £100 million - £500 million
- O £50 million - £100 million
- O £10 million - £50 million
- O £2 million - £10 million
- O < £2 million

Please describe the nature of your 'customers': (tick all that apply)

- [ ] Other organisations or businesses
- [ ] Individual consumers (e.g. the general public)
- [ ] Governments

What type(s) of value chain activities is your firm currently engaged in? (Tick all that apply)

- [ ] Research
- [ ] Design of development of products and services
- [ ] Production
- [ ] Logistics and distribution
- [ ] Sales and marketing
- [ ] After sales services

Please indicate the average percentage of your firm's total expenditure spent on Research and Development (R&D) activities during the last 3 years

_____

Please describe the category that best describes the current geographical markets served by your firm (tick all that apply)

- [ ] Local region
- [ ] United Kingdom
- [ ] Europe
- [ ] Rest of the world

Please indicate the management level of your current position

- O Executive
- O Senior management
- O Middle management
- O Junior management

Please indicate your current job function

- O Accounting/Finance
- O General management/Human Resources
- O Marketing/Sales
- O Production/Manufacturing
- O Planning
- O Purchasing/Procurement
- O Logistics/Distribution
- O Research and Development

O Legal

O Supply Chain

O Other _____

Please indicate how many years have you been working for this company

_____

Interaction Capability

This section of the questionnaire will ask you some questions about the effectiveness of your firm in a number of areas relating to your interaction with larger business customers. When answering, please think of your 'average' effectiveness across larger customer relationships, and reply as sincerely as possible.

Q1-1 Please rate the effectiveness of your firm in the following activities, relative to your major competitors (1=not effective at all to 7=extremely effective).

	Not effective at all						Extremely effective	Not Applicable
Developing internal skills and knowledge during joint projects with larger customers	O	O	O	O	O	O	O	O
Combining knowledge with larger customers to develop new products	O	O	O	O	O	O	O	O
Gaining knowledge from visits to larger customers	O	O	O	O	O	O	O	O

Forming cross-functional, cross-hierarchical teams with larger customers to facilitate knowledge exchange	O	O	O	O	O	O	O	O
Working with larger customers to build new or common areas of expertise	O	O	O	O	O	O	O	O

Q1-2 Please rate the effectiveness of your firm in the following activities, relative to your major competitors (1=not effective at all to 7=extremely effective).

	Not effective at all						Extremely effective	Not Applicable
Developing new ways to integrate our technological systems with those of larger customers	O	O	O	O	O	O	O	O
Customising our technological systems to those of larger customers	O	O	O	O	O	O	O	O
Developing our systems/technology according to larger customers' wishes	O	O	O	O	O	O	O	O
Developing new technology through joint R&D activities with larger customers	O	O	O	O	O	O	O	O

Achieving technological innovation through larger customer interaction	O	O	O	O	O	O	O	O
Adapting our technologies to new large customers to provide customised service offerings	O	O	O	O	O	O	O	O

Q1-3 Please rate the effectiveness of your firm in the following activities, relative to your major competitors (1=not effective at all to 7=extremely effective).

	Not effective at all						Extremely effective	Not Applicable
Planning jointly with large customers	O	O	O	O	O	O	O	O
Developing business plans in collaboration with larger customers	O	O	O	O	O	O	O	O
Solving joint problems with larger customers	O	O	O	O	O	O	O	O
Including larger customers in our goal-setting activities	O	O	O	O	O	O	O	O

Aligning our strategy with the strategy of larger customers	O	O	O	O	O	O	O	O
Understanding larger customers' strategic plans	O	O	O	O	O	O	O	O
Incorporating larger customer requirements into our plans, policies and objectives	O	O	O	O	O	O	O	O
Assisting larger customers in their planning activities	O	O	O	O	O	O	O	O
Responding to larger customers' planning activities	O	O	O	O	O	O	O	O

Q1-4 Please rate the effectiveness of your firm in the following activities, relative to your major competitors (1=not effective at all to 7=extremely effective).

	Not effective at all						Extremely effective	Not Applicable
Tolerating the culture of larger customers	O	O	O	O	O	O	O	O
Developing common working culture and values with larger customers	O	O	O	O	O	O	O	O
Adapting to larger customers' values and culture	O	O	O	O	O	O	O	O
Treating larger customers as friends irrespective of their culture	O	O	O	O	O	O	O	O

Changing our culture and values when a larger customer requires it	O	O	O	O	O	O	O	O
Integrating our culture and values with those of larger customers	O	O	O	O	O	O	O	O

Each of the following items consists of a pair of statements which represent the two extremes regarding the different ways in which businesses may compete.

Q2-1 Please consider each of the following pairs of statements as they relate to your business, relative to your major competitors. Indicate which position on the scale between the two polar extremes best describes the emphasis you have placed on each in establishing your ***current*** competitive position.

Providing a narrow range of products	O	O	O	O	O	O	O	Providing a broad range of products
Providing products with narrow usage	O	O	O	O	O	O	O	Providing products with broad usage
Continued new product development	O	O	O	O	O	O	O	Maintaining current products
Serving limited or specific geographical markets	O	O	O	O	O	O	O	Serving broad (global) markets
Selling products to one market segment	O	O	O	O	O	O	O	Selling products to numerous market segments
Small number of customers	O	O	O	O	O	O	O	Large number of customers
Single channel of distribution	O	O	O	O	O	O	O	Many channels of distribution
No backward integration towards suppliers and raw materials	O	O	O	O	O	O	O	Extensive backward integration towards suppliers and raw materials

No forward integration towards customers and consumers	O	O	O	O	O	O	O	Extensive forward integration towards customers and consumers
Narrow range of diversification into related businesses	O	O	O	O	O	O	O	Wide range of diversification into related businesses
Narrow range of diversification into unrelated businesses	O	O	O	O	O	O	O	Wide range of diversification into unrelated businesses

Q2-2 Please consider each of the following pairs of statements as they relate to your business, relative to your major competitors. Indicate which position on the scale between the two polar extremes best describes the emphasis you have placed on each in establishing your *future* competitive position.

Providing a narrow range of products	O	O	O	O	O	O	O	Providing a broad range of products
Providing products with narrow usage	O	O	O	O	O	O	O	Providing products with broad usage
Continued new product development	O	O	O	O	O	O	O	Maintaining current products
Serving limited or specific geographical markets	O	O	O	O	O	O	O	Serving broad (global) markets
Selling products to one market segment	O	O	O	O	O	O	O	Selling products to numerous market segments
Small number of customers	O	O	O	O	O	O	O	Large number of customers
Single channel of distribution	O	O	O	O	O	O	O	Many channels of distribution

No backward integration towards suppliers and raw materials	O	O	O	O	O	O	O	Extensive backward integration towards suppliers and raw materials
No forward integration towards customers and consumers	O	O	O	O	O	O	O	Extensive forward integration towards customers and consumers
Narrow range of diversification into related businesses	O	O	O	O	O	O	O	Wide range of diversification into related businesses
Narrow range of diversification into unrelated businesses	O	O	O	O	O	O	O	Wide range of diversification into unrelated businesses

Q2-3 Please indicate the ***expected degree of change*** in the following commercial aspects of your firm in the near future.

	Significant decrease			No change			Significant increase
Range of products offered	O	O	O	O	O	O	O
Extent of product usage	O	O	O	O	O	O	O
New product development	O	O	O	O	O	O	O
Number of geographic markets served	O	O	O	O	O	O	O
Market segments	O	O	O	O	O	O	O
Number of customers	O	O	O	O	O	O	O
Channels of distribution	O	O	O	O	O	O	O
Backward integration	O	O	O	O	O	O	O

Forward integration	O	O	O	O	O	O	O
Diversification into related businesses	O	O	O	O	O	O	O
Diversification into unrelated businesses	O	O	O	O	O	O	O

Performance Outcomes

Q3-1 Please evaluate your performance relative to major competitors for each of the following six measures.

	Worst in industry						Best in industry
Return on investment (ROI)	O	O	O	O	O	O	O
ROI growth	O	O	O	O	O	O	O
Gross income	O	O	O	O	O	O	O
Income growth	O	O	O	O	O	O	O
Net profit	O	O	O	O	O	O	O
Net profit growth	O	O	O	O	O	O	O

High Value Manufacturing

Rank your basis of competition in order of preference from 1 (least liked) to 4 (most liked)

_____ Cost (1)

_____ Quality (2)

_____ Flexibility (3)

_____ Responsiveness (4)

How would you define High Value Manufacturing (HVM)?

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree	Do not know
Application of new processes and technologies	O	O	O	O	O	O	O	O
Involvement in traditional, new and emerging industries	O	O	O	O	O	O	O	O
High skilled employees or high level of investment	O	O	O	O	O	O	O	O

Would you like to participate in a second round of this survey?

- O Yes (4)
- O No (5)

Last question!

In the next stage of this work, we would like to 'match' your company with a larger customer of yours. If you would like to help us, please provide the name of one of your major business customers.

You could also write down the email address of the main contact.

Appendix F **Participant information leaflet**

Study Title:	How development of interaction capabilities among SMEs influence them to increase participation in high value manufacturing (HVM) global value chains (GVCs).
Investigator(s):	Zakiah Syamra' Suhaimi supervised by Prof Jan Godsell

Introduction

You are invited to take part in a study. Before you decide, you need to understand why the study is being done and what it would involve for you. Please take the time to read the following information carefully. Talk to others about the study if you wish.

(Part 1 tells you the purpose of the study and what will happen to you if you take part. Part 2 gives you more detailed information about the conduct of the study)

Please ask us if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

PART 1

What is the study about?

The purpose of this study is to examine whether interaction capabilities could help SMEs to grow their business in high value manufacturing (HVM) supply chains (SCs). To participate in these markets, certain types of capabilities currently lacking in SMEs, may be needed. Thus, this study will identify which types of capabilities can help SMEs to grow their business; SMEs who have been equipped with these capabilities will be able to extend their current product lines, introduce new product, expand into new geographical markets or diversify into related/unrelated business activities. Moreover, the research will test whether growth in business will help SMEs to improve their business performance.

Do I have to take part?

It is entirely up to you to decide. We will describe the study and go through this information sheet, which we will give you to keep. If you choose to participate, we will ask you to sign a consent form to confirm that you have agreed to take part. You will be free to withdraw at any time, without giving a reason and this will not affect you or your circumstances in any way.

What will happen to me if I take part?

If you decide to take part, you will be invited to attend a semi-structured interview. The interview will be individual and last for approx. 2-3 hours and will be held at your company premises. Upon receiving your consent for recording the interview, the interview will be audio-recorded for data collection/analysis purposes.

What are the possible disadvantages, side effects, risks, and/or discomforts of taking part in this study?

No known side effects. You have the right to withdraw at any time if you feel uncomfortable.

What are the possible benefits of taking part in this study?

The study will help to increase the understanding of SMEs on certain capabilities which can be developed in order grow business with customers. By developing these capabilities, SMEs can sustain their position and subsequently upgrade their current position in the market.

Expenses and payments

No payments or reimbursements will be offered for participation in this study.

What will happen when the study ends?

The data collected through the interviews will be stored on the hard drive of a computer within Warwick Manufacturing Group. The data will be analysed by myself and shared with my supervisors (Prof Jan Godsell and Dr Antony Karatzas) and other researchers with whom we plan to publish together in the future. The data will be kept for ten years and per University of Warwick regulations.

Will my taking part be kept confidential?

Yes. We will follow strict ethical and legal practice and all information about you will be handled in confidence. Further details are included in Part 2.

What if there is a problem?

Any complaint about the way you have been dealt with during the study or any possible harm that you might suffer will be addressed. Detailed information is given in Part 2.

This concludes Part 1.

If the information in Part 1 has interested you and you are considering participation, please read the additional information in Part 2 before making any decision.

PART 2

Who is organising and funding the study?

This project is being undertaken as part of a PhD qualification at the University of Warwick. No external funding has been received to undertake this project.

What if there is a problem?

This study is covered by the University of Warwick's insurance and indemnity cover. If you have an issue, please contact the Chief Investigator of the study: z.s.b.suhaimi@warwick.ac.uk or j.godsell@warwick.ac.uk

Who should I contact if I wish to make a complaint?

Any complaint about the way you have been dealt with during the study or any possible harm you might have suffered will be addressed. Please address your complaint to the person below, who is a senior University of Warwick official entirely independent of this study:

Head of Research Governance
Research & Impact Services
University House
University of Warwick
Coventry
CV4 8UW
Tel: 024 76 522746
Email: researchgovernance@warwick.ac.uk

Will my taking part be kept confidential?

Yes. The information provided by you will be anonymised and all data will be kept confidential. More specifically, the following measures will be put in place to ensure confidentiality and anonymity of participants:

• The interviewees will be identified with a number and the function in which they work;

• The questions will avoid asking any other information that can help to identify the interviewees;

• The names emerging during the interviews will be only used for the scheduling of the interviews, and omitted in all the further reports;

• The primary research data will be accessed and managed only by myself, supervisors (Prof Jan Godsell and Dr Antony Karatzas) and other researchers with whom we plan to publish together in the future;

• The collected data will be stored on the hard drive of a computer within Warwick Manufacturing Group in electronic format for ten years as per the University of Warwick policy. The data will form the basis for further analyses and for the achievement of the objectives of the project. The results will be used and discussed in the researcher's dissertation.

What will happen to the results of the study?

The results will be used and discussed in the researcher's dissertation as part of the program. The results will also be used in any journals that the researcher plans to publish and it may be discussed at any conferences or seminars that the researcher will attend.

Who has reviewed the study?

This study has been reviewed and given favourable opinion by the University of Warwick's Biomedical and Scientific Research Ethics Committee (BSREC).

What if I want more information about the study?

If you have any questions about any aspect of the study, or your participation in it, not answered by this participant information leaflet, please contact:

Zakiah Syamra' Suhaimi. Email: z.s.b.suhaimi@warwick.ac.uk

Janet Godsell. Email: j.godsell@warwick.ac.uk

Thank you for taking the time to read this participant information leaflet.

Appendix G **Interview protocol**

Semi- structured Interview Schedule

Research Context

Section	Topic	Points to address
1	**Company structure**	**Organisation structure** - part of a parent group - operating company organisational structure - local and remote functions - senior management team **Size of company** - number of employees: direct and indirect - turnover – group and operating facility
2	**Organisational/ Business strategy**	**Operating company's mission, vision and company values** **Business strategy at group, operating company and functional level** - company's mission, vision and values **Strategy deployment mechanism** **Industry structure** - Sectors and where they operate - Growing, stable or declining **Competitors** - Major competitors - Strengths Weaknesses Opportunities and Threats (SWOT) for operating company and the two key competitors
3	**Customer Base**	**Key customers** - Definition of small, medium and large customers - Key customers - Tier of customers - Revenue accounted - Years of relationships - Main issues
4	**Growth**	**Strategies used to grow the business (based on Ansoff's matrix)**

Research Content

Section	Topic	Points to address
1	**Capabilities**	**To validate findings from survey questionnaire and seek clarifications** - Human interaction capability directly improves SMEs' business performance - Managerial interaction capability increases SMEs' participation - SMEs' participation improves firm performance - Development of human interaction capability supports development of technological interaction capability and human interaction capability - 100 points split into four interaction capabilities based on importance

Appendix H **Ethics approval**

PRIVATE
Miss Zakiah Suhaimi
WMG
University of Warwick
Coventry
CV4 7AL

6 September 2018

Dear Miss Suhaimi

Study Title and BSREC Reference: *How development of interaction capabilities among SMEs influence them to increase participation in high value manufacturing (HVM) global value chains (GVCs)?* REGO-2017-2033 AM01

Thank you for submitting a substantial amendment application for the above-named project to the University of Warwick's Biomedical and Scientific Research Ethics Sub-Committee.

I am pleased to confirm that the changes that you wish to make to this study have been approved.

Please keep a copy of the signed version of this letter with your study documentation.

Yours sincerely

[redacted]

Dr David Ellard
Chair
Biomedical and Scientific
Research Ethics Sub-Committee

[redacted]

http://www2.warwick.ac.uk/services/ris/research_integrity/researchethicscommittees/biomed

www.warwick.ac.uk